REAL AND REACTIVE POWER FLOW TRACING IN POWER NETWORKS

AHMED FIAZ

ELECTRICAL & ELECTRONICS ENGINEERING
UNIVERSITI TEKNOLOGI PETRONAS
JUNE 2010

REAL AND REACTIVE POWER FLOW TRACING IN POWER NETWORKS

By

Ahmed Fiaz

FINAL PROJECT REPORT

Submitted to the Electrical & Electronics Engineering Programme
in Partial Fulfillment of the Requirements
for the Degree
Bachelor of Engineering (Hons)
(Electrical & Electronics Engineering)

Universiti Teknologi Petronas
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

REAL AND REACTIVE POWER FLOW TRACING IN POWER NETWORKS

by

Ahmed Fiaz

Draft Report submitted to the
Electrical & Electronics Engineering Programme
Universiti Teknologi PETRONAS
in partial fulfilment of the requirement for the
Bachelor of Engineering (Hons)
(Electrical & Electronics Engineering)

Approved:

____

Dr. Nursyarizal Bin Mohd Nor

Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

JUNE 2010

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

Ahmed Fiaz

ABSTRACT

In a deregulated electric power system, energy exchanges may exist depending on load following contracts between agents belonging to different areas. Deregulation in power industry demands wide access to transmission networks that connect consumers and suppliers. As direct consequence of this, the need may arise for new effective technique that favor power flows along specific corridors. On the other hand, trend towards increasing transmission open access makes the current power system very complex, in such a situation, the objective of this project is to trace the flow of electricity in the power networks. As we can handle the economic problems of the required system which is being paid attention with the help of deregulation. This method will make it possible to charge the suppliers and/or generators for estimated amount of losses caused and hence it will encourage efficiency of individual generators in order to decrease the losses. Deregulation leads the electricity industry to focus attention on the costs of generation and provides an incentive for generators to reduce their costs and minimize risks. Competition will be the result of careful regulation to allow the new entrants access to the market because it is fundamental to most market reforms and also which introduced in order to reduce cost and increase efficiency. Therefore it is essential to build up MATLAB programming in order to obtain required data and communicate effectively with system participants. It is particularly effective in providing user with spontaneous information about the behavior of the system participants in deregulated environment.

ACKNOWLEDGEMENT

First and foremost, all my praise to Allah s.w.t for granting me the opportunity to complete my Final Year Project, which has proven to be a very enriching experience.

It is with pleasure that I express my heartfelt thanks to all who have assisted me either directly or indirectly during the course of this project. My gratitude goes to my supervisor, Dr. Nursyarizal Bin Mohd Nor, who helped me achieve my training objectives. I would like to acknowledge that without his guidance, all my efforts would not have been fruitful. I would also like to utmost appreciation to my colleague for their never failing cooperation in working on this project.

Last but not least to my family who have been giving me courage and advice throughout semester in order to ensure my success.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

IEEE	Institute of Electrical and Electronics Engineers
AC	Alternating Current
DC	Direct Current
GENCO	Generation Company
DISCO	Distribution Company
TRANSCO	Transmission Company
ISO	Independent System Operator

CHAPTER 1
INTRODUCTION

1.1. Background of Study

An electrical power system is an energy transportation system. In order to make it safe, convenient and efficient, we should trace the flow of electricity in the power networks for long distances. The electrical supply industry is undergoing a profound renovation worldwide. Since 1980s, however, the increased deregulation of the industry in almost every corner of the world has imposed [1]. Recent years have been a worldwide trend toward the deregulation and unbundling of the services provided by the utilities throughout the world especially in the power market. Therefore the goal is always lowering of the average consumer price and the introduction of competition, because of that the transmission network company should remain neutrality and centrally controlled to make the market is operating fairly. Many electricity markets around the world are currently in transition towards more deregulated and competitive markets.

The changes were initiated by:

- A realization that generation and distribution functions need not be monopolies.
- A feeling that public service obligations are no longer necessary.
- The cost reduction potential of competition.
- Increased fuel availability and fuel supply stability.
- The development of new technologies in power generation and information technology.
- It encourages competition.

- Consumer assured of good quality power.
- It avoids monopoly.
- Companies will supply at competitive price.

The electrical power system can be divided into three major parts.

i) Generation, the production of electricity.
ii) Transmission, the system of lines that transport the electricity from the generating plants to the area in which it will be used.
iii) Distribution, the system of lines that connect the individual customer to the electric power system.

Competitive generation provides a market within which independent firms compete on the basis of price to sell electricity directly to large industrial customers, and supply electricity, via common carrier transmission, to distributors who in turn sell to final users. Unit prices could vary by the amount of electricity purchased per period. As a result, customers would face more service options and a more complex pricing scheme. There are a number of advantages to have a variety of types of generators linked to transmission grid [2].

The first major advantage involves cost savings. At any given moment, power is supplied to the transmission grid by the firm with the lowest marginal costs. Dispatch according to merit saves resources and reduces the cost of generating electricity. Because the different plants may have different load characteristics, peak and load duration curves, generating capacity can be more fully utilized and additional capital resources saved.

The second advantage of the competitive generation is that a spot market for electricity will develop. The presence of a spot market means that less idle capacity must be maintained in order to provide a given level of service reliability.

The third advantage of completive generation is innovation. Competition not only leads firms to be more responsive to consumer demands, monitor costs more closely, and compete on the basis of price, but also provides an incentive to be innovative. Developing a new consumer service, a better method of reducing costs or a faster way of dealing with problems promises the innovator a competitive edge.

1.2. Problem Statement

1.2.1. Problem Identification

Due to nonlinear nature of power flow, it is difficult to determine transmission usage in the network accurately. Thus, models and tracing algorithms will become very heuristic in order to allocate the power flow and loss in transmission networks. To further understand the characteristics for the tracing of electricity, we anticipated two tracing algorithms, upstream-looking and downstream looking algorithm. The upstream-looking algorithm will apportion the losses to the loads and allocate the supplement charge to the generators while downstream-looking algorithm will apportion the losses to the generators and allocate the supplement charge to the loads. Using data inputs from a user, model can then be simulated in computer software. The software being used in this project for that purpose is MATLAB.

1.2.2. Project Significance

Long transmission lines are required to transmit power from remote generation sites to the population centres. The stability of the transmission system depends on the power flows through the transmission line, but load at the buses never static and always changes, either increasing or decreasing according to the system requirement [3]. Electrical loads both generate and absorb reactive power. They are inductive in nature and consumed a lot of reactive power from the transmission lines. Hence there is voltage drop on the line. So, it is clear that there will be the sending end and the receiving end voltages magnitude variation, as well as phase difference, is created.

Therefore it is important to trace the flow of electricity (Real and Reactive Power) in the power networks. The method that we shall use for the power tracing in meshed electrical network, allows the assessment of how much of real and reactive power output from a particular station goes to a particular load. Through this we can modify the existing tariffs of charging for transmission loss, reactive power and transmission services into the power networks.

In a competitive market the electrical industry has to focus on the costs of generation and provides an incentive for generators to reduce their costs and minimize risks. The electrical supply industry tended to be integrated vertically almost everywhere and power exchanges between utilities were determined by contracts. Since the 1980s, however, the increased deregulation of the industry in almost every corner of the world. Electricity was bundling up , it divided into Generation company (GENCO), Transmission company (TRANSCO) and Distribution company (DISCO) to make electricity industry more palatable for potential investors. Independent System Operator (ISO) and Power Market Operator, which may include other entities depending on the market structure, ISO is independent of the other entities, figure 1 shows the entities resulting from deregulation.

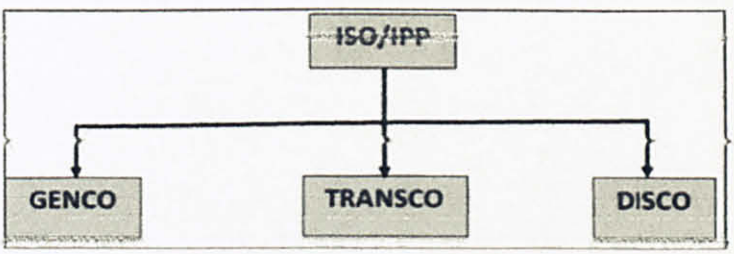

Figure: 1 Entities Resulting From Deregulation

1.3. Objectives

The main objective of this project is to trace the flow of electricity (Real and Reactive Power) in the power networks which leads the electricity industry to focus attention on the costs of generation and provides an incentive for generators to reduce their costs and minimize risks.

The main scopes of this project are:

- To build up MATLAB programming for required system as well as for bigger system.
- To trace the electricity using average line flows.
  - Upstream-looking algorithm.
  - Downstream-looking algorithm.
- To be familiar about deregulation in electrical power networks.

1.4. Scope of study

Around the world, as electricity industries are restructured and liberalized, electricity is becoming a commodity to be bought and sold by generators, suppliers and other traders [6]. This project focuses on how to improve the power networks (Transmission Lines) performance in order to decrease costs and increase efficiency. Deregulation and unbundling of transmission services has resulted in the need to assess what the impact of a particular generator or the load on the power system [1]. As vertically integrated utilities are broken up, end users and distributors are able to buy power from distant generators.

The electricity market regulations regarding fees for power exchange, the treatment of imbalances as well as the operation of the ancillary service market can have a significant impact on the economic performance of distributed generation, and hence on its future development [3]. In the new environment, utilities win because they retain rights over their transmission system and can charge what the market will bear rather than a regulated price. Consumers win because the grid innovation becomes necessary and reliability is maximized.

CHAPTER 2

LITERATURE REVIEW AND THEORY

2.1. Electrical System's Understanding

In order to conduct power flow analysis for particular power systems model, it is required to define the network topology as well as the basic components for the power flow analysis. The system includes bus, transmission line, transformer, slack generator, constant active power and constant voltage generator (PV), constant power load (PQ), constant power generator and constant admittance [5]. The primary aim of any electricity supply system is to meet all customers' demands for energy. Power generation is carried out wherever it achieves the most economic selling cost overall. The transmission system is used to transfer large amounts of energy from the main generation areas to major load caters, and distribution system carry the energy to the furthest customer, using the most appropriate voltage level [9]. The important considerations in the operation of a transmission line are the determination of voltage drop, line losses and efficiency of transmission. These values are greatly influence by the line constants R, L and C of the transmission line [4].

A transmission line has three constants R, L and C distributed uniformly along the whole length of the line. The resistance and inductance form the series impedance. the capacitance existing between conductor for 1-phase line or from a conductor to neutral for 3-phase line forms a shunt path throughout the length of the line. For instance, the voltage drop in the line depends upon the values of above three line constants [10]. Similarly, the resistance of transmission line conductors is the most important cause of power loss in the line and determines the transmission efficiency. Depending upon the manner in which capacitance is taken into account; the overhead transmission lines are classified in three types [4]:

i) Short transmission lines:

When length is up to about 50 km and line voltage is comparatively low (< 20kV), it is usually considered as short transmission line. Due to smaller length and lower voltage, the capacitance effects are small and hence can be neglected and resistance and inductance of the line are taken into account.

ii) Medium transmission Lines:

When the length is about 50-150 km and the line voltage is moderately high (> 20 kV < 100 kV), it is considered as medium transmission line. Due to the sufficient length and voltage of the line, the capacitance effects are taken into account.

iii) Long transmission lines:

When the length of an overhead transmission line is more than 150 km and line voltage is very high (> 100 kV), it is considered as a long transmission line.

2.1.1. Theory of Power Transmission

For the power transmission, the reactive and real powers are important factors. The reactive power and real power equations of figure 2 are given as [5] [6].

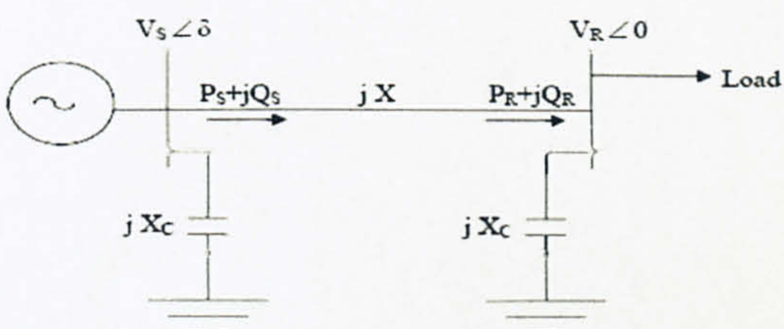

Figure 2: Simple π model two bus transmission system

$$P_S = \frac{V_S V_R}{X} \sin \delta \quad (1)$$

$$P_R = \frac{V_S V_R}{X} \sin \delta \quad (2)$$

and

$$Q_S = \frac{V_S^2 - V_S V_R \cos\delta}{X} - \frac{V_S^2}{X_C} \quad (3)$$

$$Q_R = \frac{-V_R^2 + V_S V_R \cos\delta}{X} + \frac{V_R^2}{X_C} \quad (4)$$

From eqn. 1 to eqn. 4 the receiving end and sending real and reactive power is found using voltage at receiver and sending side and phase angle difference between the voltages [5].

The phase angle difference in eqn. 1 and eqn. 2 is very small in normal power systems. Therefore the equation becomes (considering lossless system):

$$P_S = \frac{V_S V_R}{X} \delta \quad (5)$$

$$P_R = \frac{V_S V_R}{X} \delta \quad (6)$$

Ignoring the last term in reactive power equation from eqn. 3 and eqn. 4, it becomes:

$$Q_S = \frac{V_S^2 - V_S V_R \cos \delta}{X} \quad (7)$$

$$Q_R = \frac{-V_R^2 + V_S V_R \cos \delta}{X} \quad (8)$$

That means the reactive power transferred between two points is found by voltage magnitudes at two buses, series reactance of the line and cosine of the power angle between two points [5].From the above equations we can conclude that the real power flows from high angle to low whereas the reactive power flows from high voltage to low voltage bus.

2.2. Tracing the flow of electricity

This method is based on proportional sharing principle and aims at tracing the flows of electricity through power networks. It allows quantifying how much of the active and reactive power flows from a particular source to specific load. It also allows quantifying the contribution from each generator or load to flows and losses in a given line. As deregulation leads every electrical industry to pay an attention on the costs of generation and provides an incentive for generator to reduce their costs and minimize risks. It affects the existing plants way that are run and operated [1]. New plants are being built on more short-term, cost-based decisions. Long term investments such as large scale expensive power plants are not favoured in deregulated markets where customers cannot be secured. So continuing the trend towards deregulation and unbundling of transmission services has resulted in the need to assess, what the impact of a particular generator or load is on the power system [1]. Tracing of electricity allows the assessment of contributions of individual generators (or loads) to individual line flows. A loss apportioning algorithm has also been introduced which allows the breakdown of the total transmission loss into components to be allocated to individual loads or generators [11].

- **Assumption:**

The proportional sharing principle can be extended to all the network nodes and allows electricity to be traced in the network by a series of recursive calculations [1]. In meshed electrical networks is shown that how the flows are distributed in it. The network is assumed to be connected and described by a set of n nodes, m directed links (transmission lines or transformers), 2m flows (at both ends of each link) connected to the nodes [1]. i.e.

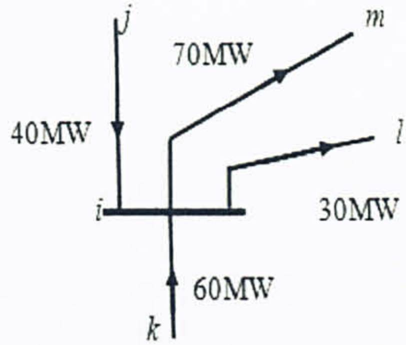

Figure: 3 Proportional Sharing Principle

The main principle used to trace the flow of electricity will be that of proportional sharing. This is illustrated in Figure 3 there are four lines (two are inflows and two are outflows) in this network; which are *j, k, m* and *l*, all are connecting at the same node at *i*.

So total power flow through the node is P*i* = 40+60 =100MW from which 40% is supplied by line *j-i* and 60% by line *k-i.* We can see from the network that $P_i = P_o$.

- **Using proportional sharing principle:**

70MW out flowing in line ***i-m*** we shall see from this line that how much power it contains from ***j-i*** and ***k-i*** respectively:

70*(40/100)=28 MW **supplied by line *j-i***

70*(60/100)=42 MW **supplied by line *k-i***

Similarly for 30 MW line ***i-l***

30*(40/100)=12 MW **supplied by line *j-i***

30*(60/100)=18 MW **supplied by line *k-i***

CHAPTER 3

METHODOLOGY

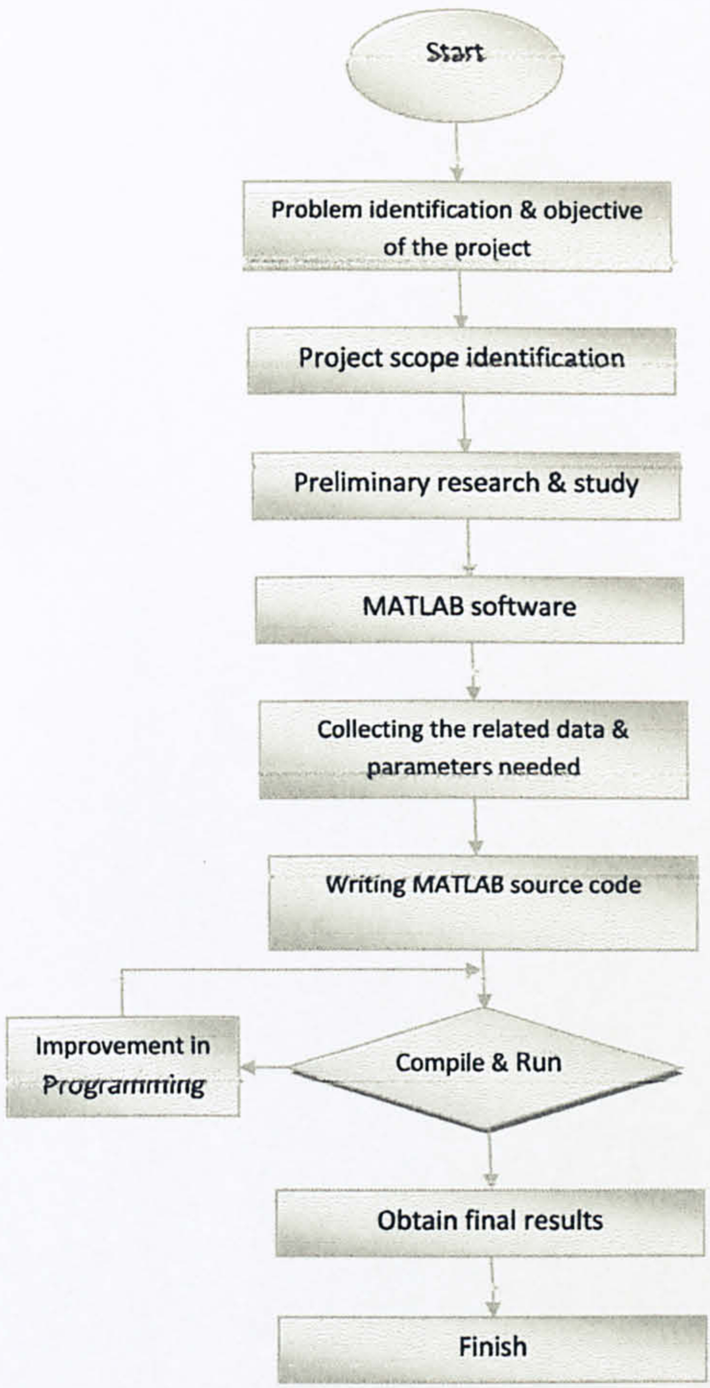

Figure 4: Process flow chart

3.1 Active Power flow using Average Line Flows

Tracing electricity can be seen as a transportation problem of determining how the power injected by the generators is distributed between lines and loads of the network. The algorithm discussed below is applicable only on lossless network wherein power flows at the beginning and end of each transmission line are equal [8]. The simplest way of obtaining lossless flows from the lossy ones is by assuming that a line flow is an average over the sending end and receiving end flows and by adding half of the line loss as load at each terminal node of the line [1]. Consider for example a simple network with 4 nodes and 5 transmission lines as shown in Figure 5. The power flow results are marked in the Figure.5 on the top or the left of a line indicates a real power flow, while a number below or to the right of the line indicates a reactive power flow. A similar convention has been used for generators and loads. Figure 6 shows a lossless real power flow obtained from the lossy network shown in Figure 5.

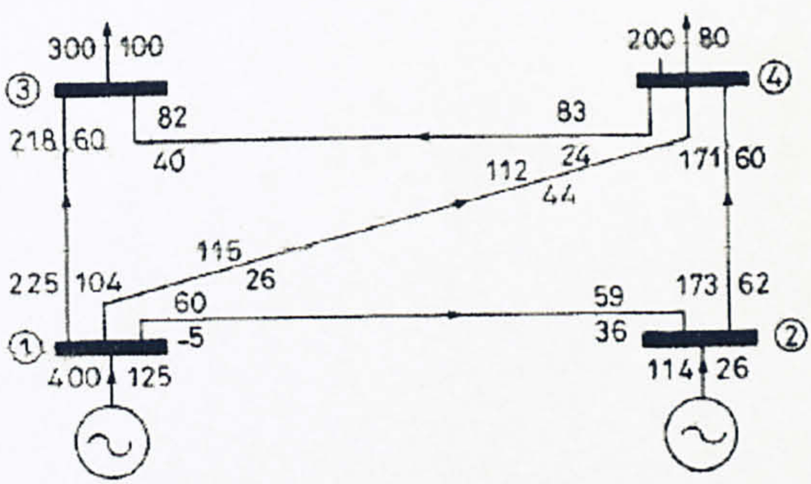

Figure5: Power flow in a 4 node network

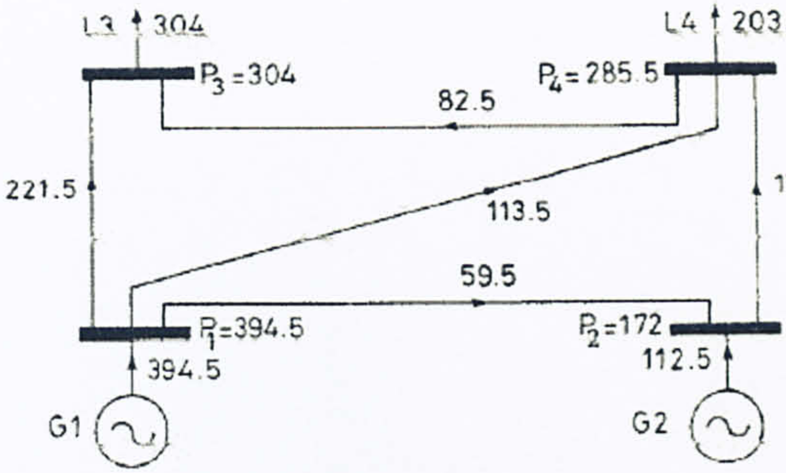

Figure 6: Lossless Power Flow

The algorithm for tracing the flow of electricity will be now derived in two versions. The upstream-looking algorithm will look at the balance of nodal inflows while the downstream-looking algorithm will look at the balance of nodal outflows.

3.1.1 Upstream-looking algorithm for active power

Let there be n nodes in the network. In the upstream-looking algorithm the power **inflows** in the lines connected at a node are considered. In node i, $P_{j\text{-}i}$ is the power that flows from node j to node i. considering the inflows, node power P_i can be written as

$P_i = P_{Gi} + \sum_{j \in \propto iu} P_{j\text{-}i}$ for i=1,2,3, …, n (1)

Where $\propto iu$ is the set of nodes supplying power directly to node i. Here

$P_{j\text{-}i} = c_{ji} P_j$ (2)

Where $C_{ji} = P_{j\text{-}i}/P_j$ (3)

Substituting eq. 2 in eq.1

$P_i = P_{Gi} + \sum_{j \in \propto iu} c_{ji} P_j$ for i=1,2,3, …, n (4)

On rearrangement

$P_{Gi} = P_i + \sum_{j\in\alpha_{iu}} c_{ji} P_j$ for i=1,2, ..., n (5)

The above n equation can be written in matrix form as

$$A_u \begin{bmatrix} P_1 \\ P_2 \\ . \\ . \\ . \\ P_n \end{bmatrix} = \begin{bmatrix} P_{G1} \\ P_{G2} \\ . \\ . \\ . \\ P_{Gn} \end{bmatrix} \quad (6)$$

Where Au is the (n×n) upstream distribution matrix. The (i, j) element of A_u is given by

$$[\mathbf{A}_u]_{ij} = \begin{cases} 1 & \text{for } i = j \\ -c_{ji} = -|P_{j-i}|/P_j & \text{for } j \in \alpha_i^{(u)} \\ 0 & \text{otherwise} \end{cases} \quad (7)$$

Note that A_u is a sparse and unsymmetrical matrix. Finding the inverse of A_u matrix, node powers can be solved. Thus

$$\begin{bmatrix} P_1 \\ P_2 \\ . \\ . \\ . \\ P_n \end{bmatrix} = [A_u^{-1}] \begin{bmatrix} P_{G1} \\ P_{G2} \\ . \\ . \\ . \\ P_{Gn} \end{bmatrix} \quad (8)$$

Individual node powers can be written as

$P_i = \sum_{k=1}^{n} [Au^{-1}]_{ik} P_{Gk}$ for $i=1,2,3, \dots, n$

(9)

It is to be noted that the above node power P_i is also equal to the sum of load demand P_{Li} and the outflows in the line connected to node i. Thus

$$P_i = P_{Li} + \sum_{l \in \propto id} P_{i\text{-}l} \quad \text{for } i = 1,2,3, \dots, n \tag{10}$$

Where $\propto id$ is the set of nodes receiving power from node i. The outflow power $P_{i\text{-}l}$ can be calculated using proportional sharing principle as

$$|P_{i-l}| = \frac{|P_{i-l}|}{P_i} P_i \tag{11}$$

Using equ.9 in the above,

$$P_{i\text{-}l} = \frac{|P_{i-l}|}{P_i} P_i \quad \sum_{k=1}^{n} [Au^{-1}]_{ik} P_{Gk} \quad \text{for } i = 1,2,3, \dots, n \tag{12}$$

Eqn. 12 allows one to determine how the line flows are supplied from individual generators.

Further, it is to be noted $\frac{|P_{i-l}|}{P_i} P_i \quad \sum_{k=1}^{n} [Au^{-1}]_{ik} P_{Gk}$ that will give the contribution of k^{th} generator for the outflow power $P_{i\text{-}l}$.

Similar to the outflow power, the load demand P_{Li} can also be calculated using proportional sharing principle as

$$P_{Li} = (P_{Li}/P_i)\, P_i \tag{13}$$

Using eqn.9 in the above,

$$P_{Li} = \frac{P_{Li}}{P_i} P_i = \frac{P_{Li}}{P_i} \sum_{k=1}^{n} [\mathbf{A}_u^{-1}]_{ik} P_{Gk} \quad \text{for } i = 1, 2, \dots, n \tag{14}$$

It is to be noted that $(\mathbf{P_{Li}/P_i})[\mathbf{A_u^{-1}}]_{ik}\ \mathbf{P_{Gk}}$ will give the contribution of the k^{th} generator for the load power $P_{Li.}$

3.1.2 Downstream-looking algorithm for active power

This is the dual of upstream-looking algorithm. In downstream-looking algorithm the power **outflows** in the lines connected at a node are considered. In node I, P_{i-l} is power that flows from node i to node *l*, considering the outflows, node power P_i can be written as

$$P_i = P_{Li} + \sum_{l \in \propto id} P_{i-l} \qquad \text{for } i=1,2,3, \ldots, n \tag{15}$$

Where $\propto id$ is the set of nodes receiving power directly to node i. Here

$$P_{i-l} = c_{il}\, P_l \tag{16}$$

$$\text{Where } C_{li} = P_{i-l}/P_l \tag{17}$$

Substituting eqn.16 in eqn. 15

$$P_i = P_{Li} + \sum_{l \in \propto id} P_l c_{il} \qquad A_d P = P_L \qquad \text{for } i=1,2,3, \ldots, n \tag{18}$$

Rearranging the above eqn.

$$P_{Li} = P_i - \sum_{l \in \propto id} P_l c_{il} \qquad A_d P = P_L \qquad \text{for } i=1,2,3, \ldots, n \tag{19}$$

The above n equation can be written in matrix form as

$$A_d \begin{pmatrix} P_1 \\ P_2 \\ . \\ . \\ . \\ P_n \end{pmatrix} = \begin{pmatrix} P_{L1} \\ P_{L2} \\ . \\ . \\ . \\ P_{Ln} \end{pmatrix} \tag{20}$$

Where $\mathbf{A_d}$ is the (n ×n) downstream distribution matrix. The (i, l) element of A_d is given as

$$\left[A_d\right] = \begin{cases} 1 & \text{for } i=l \\ -C_{il} = -P_{i-l}/P_l & \text{for } l \in \alpha id \\ 0 & \text{Otherwise} \end{cases} \tag{21}$$

Note that A_d is a sparse and unsymmetrical matrix. Finding the inverse of A_d matrix, note powers can be solved. Thus

$$\begin{bmatrix} P_1 \\ P_2 \\ . \\ . \\ . \\ P_n \end{bmatrix} = [\, A_d^{-1} \,] \begin{bmatrix} P_{L1} \\ P_{L2} \\ . \\ . \\ . \\ P_{Ln} \end{bmatrix} \tag{22}$$

Individual node power can be written as

$$P_i = \sum_{k=1}^{n} \ [A_d^{-1}]_{ik}\, P_{Lk} \qquad \text{for } \ i = 1,2,3, \ldots, n \tag{23}$$

It is to be noted that the above node power P_i is also equal to sum of generator powers P_{Gi} and the inflows in the lines connected to node i. Thus

$$P_i = P_{Gi} + \sum_{j \in \alpha iu} P_{j\text{-}i} \qquad \text{for } i = 1, 2, 3, \ldots, n \tag{24}$$

The inflow power $P_{j\text{-}i}$ can be calculated using proportional sharing principle as

$$P_{j\text{-}i} = (P_{j\text{-}i}/P_i)\, P_i \tag{25}$$

Using eqn. 23 in the above

$$P_{i\text{-}l} = (P_{j\text{-}i}/P_i)\, Pi = (P_{j\text{-}i}/P_i) \sum_{k=1}^{n} \ [A_d^{-1}]_{ik}\, P_{Lk} \qquad \text{for } \ i = 1,2,3, \ldots, n \tag{26}$$

Above equation allows one to determine how the line flow contributes to individual loads. Further, it is to be noted that $\mathbf{(P_{j\text{-}i}/P_i)\ [A_d^{-1}]_{ik}\ P_{Lk}}$ it will give the contribution of the inflow power $P_{j\text{-}i}$ to the k^{th} load.

Similar to the inflow power, the generator power P_{Gi} can also be calculated using proportional sharing principle as

$$P_{Gi} = (P_{Gi}/P_i)\, P_i \tag{27}$$

Using eqn.23 in the above,

$$P_{Gi} = (P_{Gi}/P_i)\, Pi = (P_{Gi}/P_i) \sum_{k=1}^{n} [A_{d-}^{\ 1}]_{ik}\, P_{Lk} \qquad \text{for } i = 1,2,3, \ldots, n \tag{28}$$

It is noted that $(P_{Gi}/_i)\ [A_{d-}^{\ 1}]_{ik}\, P_{Lk}$ will give the contribution of the generator power P_{Gi} to the k^{th} load.

By using MATLAB we can get the inverse of any matrix as given below:

```
A =

    1.0000         0         0         0
   -0.1508    1.0000         0         0
   -0.5615         0    1.0000   -0.2890
   -0.2877   -1.0000         0    1.0000

>> inv(A)

ans =

    1.0000         0         0         0
    0.1508    1.0000         0         0
    0.6882    0.2890    1.0000    0.2890
    0.4385    1.0000         0    1.0000

>> B=inv(A);
>> A*B

ans =

    1.0000         0         0         0
         0    1.0000         0         0
         0         0    1.0000         0
         0         0         0    1.0000
```

Figure 7: $A=A_u$ and inv(A) $=A_u^{-1}$

3.2 Reactive Power flow:

As the only requirement for the proposed method is that Kirchhoff,s Current Law must be obeyed, the method is equally well applicable to trace reative power flows. The main problem is the reative power loss of a line may be quite considerable when compared with the flow itself. Below figure 9 shows the lossless reactive power flows obtained from lossy one shown in figure 8. In figure 9 we added fititious nodes in order to get lossless power flow for network we can not apply average line flow over sending and receing end because there is large difference between sending and receiving end power. In order to handle this problem we added additional fictitious nodes responsible for the reactive power generation and consumption in each of the lines in figure 9.

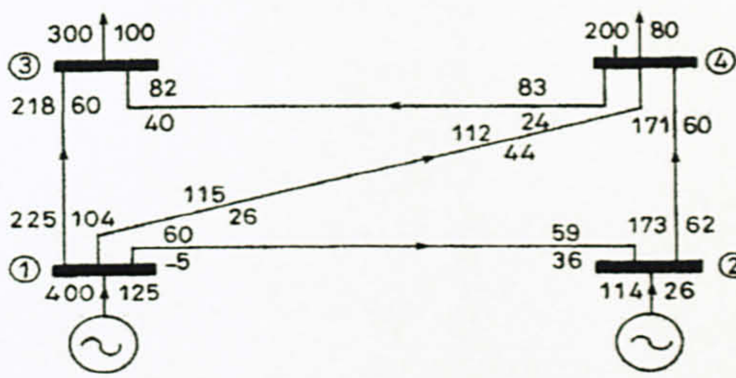

Figure 8 AC POWER FLOW IN FOUR NODE NETWORKS

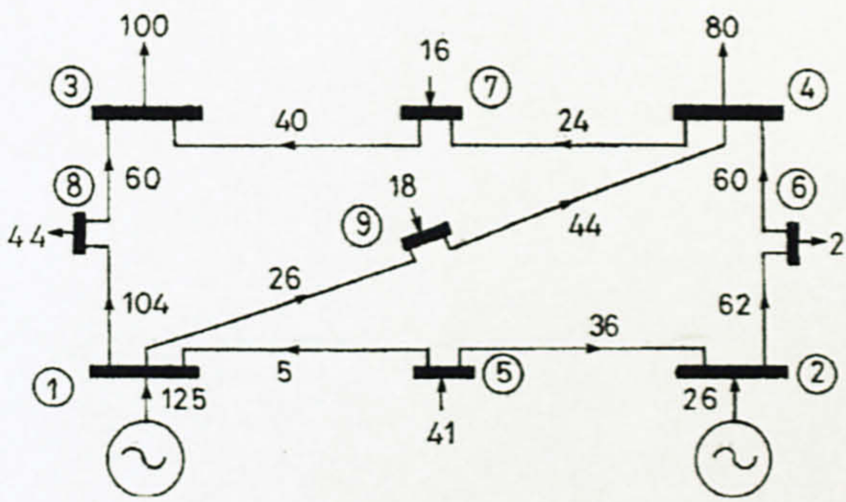

Figure 9 REACTIVE POWER FLOW WITH FICTITIOUS LINE NODES

3.2.1 Upstream-Looking Algorithm For Reactive Power Flow:

Let there be n nodes in the network. In the upstream-looking algorithm the power **inflows** in the lines connected at a node are considered. In node i, $Q_{j\text{-}i}$ is the power that flows from node j to node i. considering the inflows, node power Q_i can be written as

$$Q_i = Q_{Gi} + \sum_{j \in \propto iu} Q_{j\text{-}i} \qquad \text{for } i=1,2,\ldots, n \tag{29}$$

Where $\propto iu$ is the set of nodes supplying power directly to node i. Here

$$Q_{j\text{-}i} = C_{ji}\, Q_j \tag{30}$$

$$\text{Where } C_{ji} = Q_{j\text{-}i}/Q_j \tag{31}$$

Substituting eq. 30 in eq.29

$$Q_i = Q_{Gi} + \sum_{j \in \propto iu} c_{ji}\, Q_j \qquad \text{for } i=1,2,\ldots,n \tag{32}$$

On rearrangement

$$Q_{Gi} = Q_i + \sum_{j \in \propto iu} c_{ji}\, Q_j \qquad \text{for } i=1,2,\ldots,n \tag{33}$$

The above n equation can be written in matrix form as

$$A_u \begin{bmatrix} Q_1 \\ Q_2 \\ . \\ . \\ . \\ Q_n \end{bmatrix} = \begin{bmatrix} Q_{G1} \\ Q_G \\ . \\ . \\ . \\ Q_{Gn} \end{bmatrix} \tag{34}$$

Where A_u **is the (n×n) upstream distribution matrix**. The (i, j) element of A_u is given by

$$[A_u]_{ij} = \begin{cases} 1 & \text{for } i = j \\ -c_{ji} = -Q_{j\text{-}i}/Q_i & \text{for } j \in \propto iu \\ 0 & \text{otherwise} \end{cases} \tag{35}$$

Note that A_u is a sparse and unsymmetrical matrix. Finding the inverse of A_u matrix, node powers can be solved. Thus

$$\begin{pmatrix} Q_1 \\ Q_2 \\ . \\ . \\ . \\ Q_n \end{pmatrix} = [A_u^{-1}] \begin{pmatrix} Q_{G1} \\ Q_{G2} \\ . \\ . \\ . \\ Q_{Gn} \end{pmatrix} \tag{36}$$

Individual node powers can be written as

$$Q_i = \sum_{k=1}^{n} [A_u^{-1}]_{ik} Q_{Gk} \quad \text{for } i = 1,2,3,\ldots,n \tag{37}$$

It is to be noted that the above node power P_i is also equal to the sum of load demand P_{Li} and the outflows in the line connected to node i. Thus

$$Q_i = Q_{Li} + \sum_{l \in \propto id} Q_{i\text{-}l} \quad \text{for } i = 1,2,3,\ldots,n \tag{38}$$

Where $\propto id$ is the set of nodes receiving power from node i. The outflow power $Q_{i\text{-}l}$ can be calculated using proportional sharing principle as

$$Q_{i\text{-}l} = (Q_{i\text{-}l}/Q_i)\, Q_i \tag{39}$$

Using equ.37 in the above,

$$Q_{i-l} = (Q_{i-l}/Q_i)\, Q_i = (Q_{i-l}/Q_i)\sum_{k=1}^{n} [Au^{-1}]_{ik}\, Q_{Gk} \qquad \text{for } i = 1,2,3,\ldots,n \tag{40}$$

Eqn. 40 allows one to determine how the line flows are supplied from individual generators.

Further, it is to be noted $(Q_{i-l}/Q_i)\,[A_u^{-1}]_{ik}\, Q_{Gk}$ that will give the contribution of k^{th} generator for the outflow power Q_{i-l}.

Similar to the outflow power, the load demand Q_{Li} can also be calculated using proportional sharing principle as

$$Q_{Li} = (Q_{Li}/Q_i)\, Q_i \tag{41}$$

Using eqn. 37 in the above,

$$Q_{Li} = (Q_{Li}/Q_i)\, Qi = (Q_{Li}/Q_i)\sum_{k=1}^{n} [A_u^{-1}]_{ik}\, Q_{Gk} \qquad \text{for } i = 1,2,3,\ldots,n \tag{42}$$

It is to be noted that $\mathbf{(Q_{Li}/Q_i)[A_u^{-1}]_{ik}\, Q_{Gk}}$ will give the contribution of the $\mathbf{k^{th}}$ generator for the load power $\mathbf{Q_{Li}}$.

3.2.2 Downstream-Looking Algorithm For Reactive Power Flow:

Above figure 9 shows the lossless reactive power in which the nodes number from 5,6,7,8 and 9 are fictitious. Nodes 5, 7 and 9 act as the reactive power sources while nodes 6 and 8 act as the reactive power sinks. Applying the downstream looking algorithm expressed by equation.

$$Q_i = Q_{Li} + \sum_{l \in \propto id} Q_{i-l} \qquad \text{for } i=1, 2, 3, \ldots, n \tag{43}$$

Where $\propto id$ is the set of nodes receiving power directly from node i. Here

$$Q_{i-l} = c_{il}\, Q_l \tag{44}$$

$$\text{Where } c_{il} = Q_{i-l}/Q_l \tag{45}$$

Substituting eq.44 in eq.43

$$Q_i = Q_{Li} - \sum_{l \in \propto id} C_{li} Q_l \qquad A_d Q = Q_L \qquad \text{for } i=1,2,3, \ldots, n \tag{46}$$

Rearranging above equation

$$Q_{Li} = Q_i + \sum_{l \in \propto id} Q_l\, c_{il} \qquad A_d Q = Q_L \qquad \text{for } i=1,2,3, \ldots, n \tag{47}$$

Rearranging above n equations can be written in matrix form as,

$$A_d \begin{bmatrix} Q_1 \\ Q_2 \\ . \\ . \\ . \\ Q_n \end{bmatrix} = \begin{bmatrix} Q_{L1} \\ Q_{L2} \\ . \\ . \\ . \\ Q_{Ln} \end{bmatrix} \tag{48}$$

Where A_d is the (n ×n) **downstream distribution matrix**. The (i, l) element of A_d is given by

$$[A_d] = \begin{cases} 1 & \text{for } i=l \\ -C_{il} = -Q_{i-l}/Q_l & \text{for } l \in \propto id \\ 0 & \text{Otherwise} \end{cases} \tag{49}$$

Note that A_d is a sparse and unsymmetrical matrix. Finding the inverse of A_d matrix, note powers can be solved. Thus

$$\begin{bmatrix} Q_1 \\ Q_2 \\ . \\ . \\ . \\ Q_n \end{bmatrix} = [A_d]^{-1} \begin{bmatrix} Q_{L1} \\ Q_{l2} \\ . \\ . \\ . \\ Q_{Ln} \end{bmatrix} \tag{50}$$

Individual node power can be written as

$$Q_i = \sum_{k=1}^{n} [A_d^{-1}]_{ik} Q_{Lk} \quad \text{for } i = 1,2,3, \ldots, n \tag{51}$$

It is to be noted that the above node power Q_i is also equal to sum of generator powers Q_{Gi} and the inflows in the lines connected to node i. Thus

$$Q_i = Q_{Gi} + \sum_{l \in \alpha i u} Q_{j\text{-}i} \quad \text{for } i = 1, 2, 3, \ldots, n \tag{52}$$

The inflow power $Q_{j\text{-}i}$ can be calculated using proportional sharing principle as

$$Q_{j\text{-}i} = (Q_{j\text{-}i}/Q_i)\, Qi \quad \text{for } i = 1, 2, 3, \ldots, n \tag{53}$$

Using eqn. 51 in the above

$$Q_{i\text{-}l} = (Q_{j\text{-}i}/Q_i)\, Qi = (Q_{j\text{-}i}/Q_i) \sum_{k=1}^{n} [A_d^{-1}]_{ik} Q_{Lk} \quad \text{for } i = 1,2,3,\ldots, n \tag{54}$$

Above eqn.54 allows one to determine how the line flow contributes to individual loads. Further, it is to be noted that $(Q_{j\text{-}i}/Q_i)\,[A_d^{-1}]_{ik} Q_{Lk}$ it will give the contribution of the inflow power $Q_{j\text{-}i}$ to the k^{th} load.

Similar to the inflow power, the generator power Q_{Gi} can also be calculated using proportional sharing principle as

$$Q_{Gi} = (Q_{Gi}/Q_i)\, Q_i \tag{55}$$

Using eqn. 51 in the above,

$$Q_{Gi} = (Q_{Gi}/Q_i)\, Qi = (Q_{Gi}/Q_i) \sum_{k=1}^{n} [A_{d\text{-}}^{1}]_{ik} Q_{Lk} \quad \text{for } i = 1,2,3,\ldots,n \tag{56}$$

It is noted that $(Q_{Gi}/Q_i)\,[A_{d\text{-}}^{1}]_{ik} Q_{Lk}$ will give the contribution of the generator power Q_{Gi} to the k^{th} load.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Results of Upstream-looking Algorithm for active power

The upstream-looking algorithm is now applied to the network shown in Fig. 6. Matrix A_u is constructed first. Here *i* vary from 1 to4 and *j* should cover the nodes supplying power directly to node *i*. *Table* 1 below shows the *j* values for different values of *i*.

Table 1: j values for different values of i

i	j values
1	--------
2	**1**
3	**1, 4**
4	**1, 2**

$A_u(2, 1) = -P_{1\text{-}2}/P_1 = -59.5/394.5 \quad = \quad -0.1508$

$A_u(3, 1) = -\ P_{1\text{-}3}/P_1 = -221/394.5 \quad = \quad -0.5615$

$A_u(3, 4) = -\ P_{4\text{-}3}/P_4 = -82.5/285.5 \quad = \quad -0.2890$

$A_u(4, 1) = -\ P_{1\text{-}4}/P_1 = -113.5/394.5 = \quad -0.2877$

$A_u(4, 2) = -\ P_{2\text{-}4}/P_2 = -172/172 \quad = \quad -1$

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ -0.1508 & 1 & 0 & 0 \\ & & & \end{pmatrix}$$

A_u	=	-0.5615	0	1	-0.2890
		-0.2877	-1	0	1

And hence, By using MATLAB the matrix of A_u^{-1} given below:

```
A =

    1.0000         0         0         0
   -0.1508    1.0000         0         0
   -0.5615         0    1.0000   -0.2890
   -0.2877   -1.0000         0    1.0000

>> inv(A)

ans =

    1.0000         0         0         0
    0.1508    1.0000         0         0
    0.6882    0.2890    1.0000    0.2890
    0.4385    1.0000         0    1.0000

>> B=inv(A);
>> A*B

ans =

    1.0000         0         0         0
         0    1.0000         0         0
         0         0    1.0000         0
         0         0         0    1.0000
```

Using $(P_{i-l}/P_i)[A_u^{-1}]_{ik} P_{Gk}$, contribution of generators for the outflow powers can be calculated. The results are shown in Table 2.

Table 2: Contribution of generators for the outflow powers

Line i-l	From P_{G1}	From P_{G2}	Total outflow
1-2	$\frac{59.5}{394.5}\times1\times394.5=59.5$	$\frac{59.5}{394.5}\times0\times112.5=0$	59.5
1-3	$\frac{221.5}{394.5}\times1\times394.5=221.5$	$\frac{221.5}{394.5}\times0\times112.5=0$	221.5
1-4	$\frac{113.5}{394.5}\times1\times394.5=113.5$	$\frac{113.5}{394.5}\times0\times112.5=0$	113.5
2-4	$\frac{172}{172}\times0.1508\times394.5=59.4906$	$\frac{172}{172}\times1\times112.5=112.5$	171.9906
4-3	$\frac{82.5}{285.5}\times0.4385\times394.5=49.9878$	$\frac{82.5}{285.5}\times1\times112.5=32.5088$	82.4966

Using $(P_{Li}/P_i)[A_u^{-1}]_{ik} P_{Gk}$, contribution of generators to meet the load powers can be calculated. The results are shown in Table 3.

Table 3: Contribution of generators to meet the load powers

Load	From P_{G1}	From P_{G2}	Total Load Power
L_3	$\frac{304}{304}\times0.6882\times394.5=271.4912$	$\frac{304}{304}\times0.289\times112.5=32.5088$	304.007
L_4	$\frac{203}{285.5}\times0.4385\times394.5=123.0004$	$\frac{203}{285.5}\times1\times112.5=79.9912$	202.9916
Total	394.4953	112.5037	506.9990

Upstream-looking algorithm will enable us to compute the contribution of different generators for the outflow powers in the lines. Further, it is possible to find out the share each load, supplied by the different generators.

4.2 Results Of Up-Stream Looking Algorithm For Real Power From Appendix C

Contribution Of Generator (1) For Outflow Powers For Line =

0	59.5000	221.5000	113.5000
0	0	0	59.5000
0	0	0	0
0	0	49.9912	0

Contribution Of Generator (2) For Outflow Powers For Line =

0	0	0	0
0	0	0	112.5000
0	0	0	0
0	0	32.5088	0

PLoad3FromGEN1 = 271.4912

PLoad4FromGEN1 = 123.0088

PLoad3FromGEN2 = 32.5088

PLoad4FromGEN2 = 79.9912

Comparing Few Results

% error = (|Your Result - Accepted Value| / Accepted Value) x 100

%error for Line 1-2 From GEN 1= [(59.5-59.5)/59.5]*100 = 0

%error for Line 1-3 From GEN 1= [(221.5-221.5)/221.5]*100 = 0

%error for Line 2-4 From GEN 2= [(112.5-112.5)/112.5]*100 = 0

%error for Line 4-3 From GEN 2= [(32.5088-32.5088)/ 32.5088]*100 = 0

%error for Load 3 From GEN 1= [(271.4912-271.4912)/ 271.4912]*100 = 0

%error for Load 3 From GEN 2= [(32.5088-32.5088)/ 32.5088]*100 = 0

4.3 Results of Downstream-looking Algorithm for active power

This algorithm is now applied to the network shown in Fig. 6. Matrix A_d is constructed first. Here i vary from 1 to 4 and l should cover the nodes receiving power directly from node i.

Table 4: *l* values for different values of *i*.

i	*l* values
1	2, 3, 4
2	4
3	--
4	3

$A_d(1, 2) = -P_{1\text{-}2}/ P_2 = - 59.5/172 = -0.3459$

$A_d(1, 3) = - P_{1\text{-}3}/ P_3 = - 221.5/304 =-0.7286$

$A_d(1, 4) = - P_{1\text{-}4}/ P_4 = - 113.5/285.5 = -0.3975$

$A_d(2, 4) = - P_{2\text{-}4}/ P_4 = - 172/285.5 =-0.6025$

$A_d(4,3) = - P_{4\text{-}3}/ P_3 = - 82.5/304 =-0.2714$

Thus

$$[A_d]= \begin{bmatrix} 1.0000 & -0.3459 & -0.7286 & -0.3975 \\ 0 & 1.0000 & 0 & -0.6025 \\ 0 & 0 & 1.0000 & 0 \\ 0 & 0 & -0.2714 & 1.0000 \end{bmatrix}$$

$$[A_d]^{-1} = \begin{bmatrix} 1.0000 & 0.3459 & 0.8930 & 0.6059 \\ 0 & 1.0000 & 0.1635 & 0.6025 \\ 0 & 0 & 1.0000 & 0 \\ 0 & 0 & 0.2714 & 1.0000 \end{bmatrix}$$

Using $(P_{j\text{-}i}/P_i)[A_d^{-1}]_{ik}\, P_{Lk}$ contribution of inflow power $P_{j\text{-}i}$ to the k^{th} load can be calculated. The results are shown in Table below:

Table 5: Contribution of inflow powers to the load powers

Line j-i	To P_{L3}	To P_{L4}	Total inflow
1-2	(59.5/172)×0.1635×304=17.1941	(59.5/172)×0.6025×203=42.3065	**59.5040**
1-3	(221.5/304)×1×304=221.5	(221.5/304)×0×203=0	**221.5**
1-4	(113.5/285.5)×0.1635×304=32.7999	(113.5/285.5)×1×203=80.7023	**113.5022**
2-4	(172/285.5)×0.2714×304=49.7056	(172/285.5)×1×203=122.2977	**172.0033**
4-3	(82.5/304)×1×304=82.5	(82.5/304)×0×203=0	**82.5**

Using $(P_{Gi}/P_i)[A_d^{-1}]_{ik}\, P_{Lk}$, contribution of generators power PGi to the kth load can be calculated. The results are shown in table below

Table 6: Contribution of generators powers to the loads

Generator	To P_{L3}	To P_{L4}	Total Generation
P_{G1}	(394.5/394.5)×0.8931×304 =271.4912	(394.5/394.5)×0.606×203 =123.008	**394.5204**
P_{G2}	(112.5/172)×0.1635×304 =32.5088	(112.5/172)×0.6025×203 =79.9912	**112.5075**
Total	**304.0123**	**203.0156**	**507.0279**

Downstream-looking algorithm will enable us to compute the contribution of inflow powers in the lines to the individual loads. Further, it is possible to find out the contribution of different generators to the different loads.

4.4 Results Of Down-Stream Looking Algorithm For Real Power From Appendix C

Contribution Of Inflow Powers To The Load Power (3) =

0	17.1935	221.5000	32.7977
0	0	0	49.7023
0	0	0	0
0	0	82.5000	0

Contribution Of Inflow Powers To The Load Power (4) =

0	42.3065	0	80.7023
0	0	0	122.2977
0	0	0	0
0	0	0	0

PG (1) To Load Power (3) = 271.4912

PG (1) To Load Power (4) = 123.0088

PG (2) To Load Power (3) = 32.5088

PG (2) To Load Power (4) = 79.9912

Comparing Few Results

% error = (|Your Result - Accepted Value| / Accepted Value) x 100

%error for Line 1-2 To Load 3= [(17.1935-17.1941)/ 17.1935]*100 = 0.0034

%error for Line 1-3 To Load 3= [(221.5-221.5)/221.5]*100 = 0

%error for Line 1-2 To Load 4= [(42.3065-42.3065)/ 42.3065]*100 = 0

%error for Line 1-4 To Load 4= [(80.7023-80.7023)/ 80.7023]*100 = 0

%error for Load 3 From GEN 1= [(271.4912-271.4912)/ 271.4912]*100 = 0

%error for Load 3 From GEN 2= [(32.5088-32.5088)/ 32.5088]*100 = 0

4.5 Results of Upstream-Looking Algorithm for Reactive Power Flow:

The upstream-looking algorithm is now applied to the network shown in Fig 9. Matrix A_u is constructed first. Here *i* vary from 1 to 9 and *j* should cover the nodes supplying power directly to node *i*. *Table* 7 below shows the *j* values for different values of *i*.

Table 7: j values for different values of i

i	j values
1	5
2	5
3	8, 7
4	6, 9
5	---
6	2
7	4
8	1
9	1

$A_u(1, 5) = -Q_{5\text{-}1}/Q_5 = -5/41 = -0.1219$

$A_u(2, 5) = -Q_{5\text{-}2}/Q_5 = -36/41 = -0.8780$

$A_u(3, 7) = -Q_{7\text{-}3}/Q_7 = -40/40 = -1$

$A_u(3, 8) = -Q_{8\text{-}3}/Q_8 = -60/104 = -0.5769$

$A_u(4, 6) = -Q_{6\text{-}4}/Q_6 = -60/62 = -0.9677$

$A_u(4, 9) = -Q_{9\text{-}4}/Q_9 = -44/44 = -1$

$A_u(6, 2) = -Q_{2\text{-}6}/Q_2 = -62/62 = -1$

$A_u(7, 4) = -Q_{4\text{-}7}/Q_4 = -24/104 \quad -0.2307$

$A_u(8, 1) = - Q_{1-8}/Q_1 = -104/130 = -0.8$

$A_u(9, 1) = - Q_{1-9}/Q_1 = -26/130 = -0.2$

$$[A_u] = \begin{bmatrix} 1.0000 & 0 & 0 & 0 & -0.1219 & 0 & 0 & 0 & 0 \\ 0 & 1.0000 & 0 & 0 & -0.8780 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1.0000 & 0 & 0 & 0 & -1.0000 & -0.5769 & 0 \\ 0 & 0 & 0 & 1.0000 & 0 & -0.9677 & 0 & 0 & -1.0000 \\ 0 & 0 & 0 & 0 & 1.0000 & 0 & 0 & 0 & 0 \\ 0 & -1.0000 & 0 & 0 & 0 & 1.0000 & 0 & 0 & 0 \\ 0 & 0 & 0 & -0.2307 & 0 & 0 & 1.0000 & 0 & 0 \\ -0.8000 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0000 & 0 \\ -0.2000 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0000 \end{bmatrix}$$

$$[A_u]^{-1} = \begin{bmatrix} 1.0000 & 0 & 0 & 0 & 0.1219 & 0 & 0 & 0 & 0 \\ 0 & 1.0000 & 0 & 0 & 0.8780 & 0 & 0 & 0 & 0 \\ 0.5077 & 0.2232 & 1.0000 & 0.2307 & 0.2579 & 0.2232 & 1.0000 & 0.5769 & 0.2307 \\ 0.2000 & 0.9677 & 0 & 1.0000 & 0.8740 & 0.9677 & 0 & 0 & 1.0000 \\ 0 & 0 & 0 & 0 & 1.0000 & 0 & 0 & 0 & 0 \\ 0 & 1.0000 & 0 & 0 & 0.8780 & 1.0000 & 0 & 0 & 0 \\ 0.0461 & 0.2232 & 0 & 0.2307 & 0.2016 & 0.2232 & 1.0000 & 0 & 0.2307 \\ 0.8000 & 0 & 0 & 0 & 0.0975 & 0 & 0 & 1.0000 & 0 \\ 0.2000 & 0 & 0 & 0 & 0.0244 & 0 & 0 & 0 & 1.0000 \end{bmatrix}$$

Using $(Q_{i\text{-}l}/Q_i)[A_u^{-1}]_{ik} Q_{Gk}$, contribution of generators for the outflow powers can be calculated. The results are shown in **Table 8** below:

Table 8: Contribution of generators for the outflow powers

Line *i-l*	From Q_{G1}	From Q_{G2}	From Q_{S5}	From Q_{S7}	From Q_{S9}	Total outflow
1-8	$\frac{104}{130}\times1\times125$ =100	$\frac{104}{130}\times0\times26$ =0	$\frac{104}{130}\times0.1219\times41$ =4	$\frac{104}{130}\times0\times16$ =0	$\frac{104}{130}\times0\times18$ =0	**103.9998**
1-9	$\frac{26}{130}\times1\times125$ =25	$\frac{26}{130}\times0\times26$ =0	$\frac{26}{130}\times0.1219\times41$ =1	$\frac{26}{130}\times0\times16$ =0	$\frac{26}{130}\times0\times18$ =0	**25.9996**
2-6	$\frac{60}{62}\times0\times125$ =0	$\frac{60}{60}\times1\times26$ =26	$\frac{60}{62}\times0.8780\times41$ =34.8367	$\frac{60}{62}\times0\times16$ =0	$\frac{60}{62}\times0\times18$ =0	**59.9979**
4-7	$\frac{24}{104}\times0.2\times125$ =5.7692	$\frac{24}{104}\times0.9677\times26$ =5.8065	$\frac{24}{104}\times0.8740\times41$ =8.2693	$\frac{24}{104}\times0\times16$ =0	$\frac{24}{104}\times1\times18$ =4.1538	**23.9947**
5-1	$\frac{5}{41}\times0\times125$ =0	$\frac{5}{41}\times0\times26$ =0	$\frac{5}{41}\times1\times41$ =5	$\frac{5}{41}\times0\times16$ =0	$\frac{5}{41}\times0\times18$ =0	**5**
5-2	$\frac{36}{41}\times0\times125$ =0	$\frac{36}{41}\times0\times26$ =0	$\frac{36}{41}\times1\times41$ =36	$\frac{36}{41}\times0\times16$ =0	$\frac{36}{41}\times0\times18$ =0	**36**
6-4	$\frac{60}{62}\times0\times125$ =0	$\frac{60}{62}\times1\times26$ =25.1612	$\frac{60}{62}\times0.8780\times41$ =34.8367	$\frac{60}{62}\times0\times16$ =0	$\frac{60}{62}\times\times18$ =0	**59.9979**
7-3	$\frac{40}{40}\times0.0461\times125$=5.7625	$\frac{40}{40}\times0.2232\times26$ =5.8032	$\frac{40}{40}\times0.2016\times41$ =8.2656	$\frac{40}{40}\times1\times16$ =16	$\frac{40}{40}\times0.2307\times18$=4.1526	**39.9839**
8-3	$\frac{60}{104}\times0.8\times125$ =57.69	$\frac{60}{104}\times0\times26$ =0	$\frac{60}{104}\times0.0975\times41$ =2.3062	$\frac{60}{104}\times0\times16$ =0	$\frac{60}{104}\times0\times18$ =0	**59.99625**
9-4	$\frac{44}{44}\times0.2\times125$ =25	$\frac{44}{44}\times0\times26$ =0	$\frac{44}{44}\times0.0244\times41$ =0.9997	$\frac{44}{44}\times0\times16$ =0	$\frac{44}{44}\times1\times18$ =18	**43.9997**

Using $(Q_{Li}/Q_i)[A_u^{-1}]_{ik}\, Q_{Gk}$, contribution of generators to meet the load powers can be calculated. The results are shown in **Table 9** below:

Table 9: Contribution of generators to meet the load powers

Load	From Q_{G1}	From Q_{G2}	From Q_{S5}	From Q_{S7}	From Q_{S9}	Total Load Power
L_3	$\frac{100}{100}\times0.5077\times125$ =63.4615	$\frac{100}{100}\times0.2232\times26$ =5.8032	$\frac{100}{100}\times0.2579\times41$ =10.5739	$\frac{100}{100}\times1\times16$ =16	$\frac{100}{100}\times0.2307\times18$ =4.1526	**99.9922**
L_4	$\frac{80}{104}\times0.2\times125$ =19.2308	$\frac{80}{104}\times0.9677\times26$ =19.3548	$\frac{80}{104}\times0.8740\times41$ =27.5646	$\frac{80}{104}\times0\times16$ =0	$\frac{80}{104}\times1\times18$ =13.8461	**79.9954**
L_6	$\frac{2}{62}\times0\times125$ =0	$\frac{2}{62}\times1\times26$ =0.8387	$\frac{2}{62}\times0.8780\times41$ =1.1612	$\frac{2}{62}\times0\times16$ =0	$\frac{2}{62}\times0\times18$ =0	**1.9999**
L_8	$\frac{44}{104}\times0.8\times125$ =42.3076	$\frac{44}{104}\times0\times26$ =0	$\frac{44}{104}\times0.0975\times41$ =1.6913	$\frac{44}{104}\times0\times16$ =0	$\frac{44}{104}\times0\times18$ =0	**43.9989**
Total	**125.0008**	**25.9959**	**40.991**	**16**	**17.9987**	

Upstream-looking algorithm will enable us to compute the contribution of different generators for the outflow powers in the lines. Further, it is possible to find out the share each load, supplied by the different generators.

4.6 Results of Up-Stream Looking Algorithm For Reactive Power From Appendix D

Contribution Of Generator (1) For Outflow Powers For Line =

0	0	0	0	0	0	0	100.0000	25.0000
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	5.7692	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	5.7692	0	0	0	0	0	0
0	0	57.6923	0	0	0	0	0	0
0	0	0	25.0000	0	0	0	0	0

Contribution Of Generator (2) For Outflow Powers For Line =

0	0	0	0	0	0	0	0	0
0	0	0	0	0	26.0000	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	5.8065	0	0
0	0	0	0	0	0	0	0	0
0	0	0	25.1613	0	0	0	0	0
0	0	5.8065	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0

Contribution Of Source (5) For Outflow Powers For Line =

0	0	0	0	0	0	0	4.0000	1.0000
0	0	0	0	0	36.0000	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	8.2705	0	0
5.0000	36.0000	0	0	0	0	0	0	0
0	0	0	34.8387	0	0	0	0	0
0	0	8.2705	0	0	0	0	0	0
0	0	2.3077	0	0	0	0	0	0
0	0	0	1.0000	0	0	0	0	0

Contribution Of Source (7) For Outflow Powers For Line =

0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	16	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0

Contribution Of Source (9) For Outflow Powers For Line =

0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	4.1538	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	4.1538	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	18.0000	0	0	0	0	0

QLoad (3) From GEN (1) = 63.4615

QLoad (4) From GEN (1) = 19.2308

QLoad (6) From GEN (1) = 0

QLoad (8) From GEN (1) = 42.3077

QLoad (3) From GEN (2) = 5.8065

QLoad (4) From GEN (2) = 19.3548

QLoad (6) From GEN (2) = 0.8387

QLoad (8) From GEN (2) = 0

QLoad (3) From Source (5) = 10.5782

QLoad (4) From Source (5) = 27.5682

QLoad (6) From Source (5) = 1.1613

QLoad (8) From Source (5) = 1.6923

QLoad (3) From Source (7) = 16

QLoad (4) From Source (7) = 0

QLoad (6) From Source (7) = 0

QLoad (8) From Source (7) = 0

QLoad (3) From Source (9) = 4.1538

QLoad (4) From Source (9) = 13.8462

QLoad (6) From Source (9) = 0

QLoad (8) From Source (9) = 0

Comparing Few Results

% error = (|Your Result - Accepted Value| / Accepted Value) x 100

%error for Line 1-8 From GEN 1= [(100-100)/ 100]*100 = 0.0034

%error for Line 4-4 From GEN 1= [(5.7692-5.7692)/ 5.7692]*100 = 0

%error for Line 2-6 From GEN 2= [(26-26)/ 26]*100 = 0

%error for Line 4-7 From GEN 2= [(5.8065-5.8065)/ 5.8065]*100 = 0

%error for Line 1-8 From Source 5= [(4-4)/ 4]*100 = 0

%error for Line 1-9 From Source 5= [(1-1)/ 1]*100 = 0

%error for Line 7-3 from Source 7= [(16-16)/ 16]*100 = 0

%error for Line 4-7 From Source 9= [(4.1538-4.1538)/ 4.1538]*100 = 0

%error for Line 9-4 From Source 9= [(18-18)/ 18]*100 = 0

%error for QLoad 3 From GEN 1 = [(63.4615-63.4615)/ 63.4615]*100 = 0

%error for QLoad 4 From GEN 1 = [(19.2308-19.2308)/ 19.2308]*100 = 0

%error for QLoad 3 From GEN 2 = [(5.8065-5.8032)/ 5.8065]*100 = 0.00056

%error for QLoad 4 From GEN 2 = [(19.3548-19.3548)/ 19.3548]*100 = 0

4.7 Results of Downstream-looking Algorithm for Reactive Power Flow:

This algorithm is now applied to the network shown in Figure 9. Matrix A_d is constructed first. Here i vary from 1 to 9 and l should cover the nodes receiving power directly from node i.

Table 10: *l* values for different values of *i*.

i	*l* values
1	8, 9
2	6
3	--
4	7
5	1, 2
6	4
7	3
8	3
9	4

$A_d(1, 8) = -Q_{1\text{-}8}/Q_8 = -104/104$

$A_d(1, 9) = -Q_{1\text{-}9}/Q_9 = -26/44$

$A_d(2, 6) = -Q_{2\text{-}6}/Q_6 = -62/62$

$A_d(4, 7) = -Q_{4\text{-}7}/Q_7 = -24/40$

$A_d(5, 1) = -Q_{5\text{-}1}/Q_1 = -5/130$

$A_d(5, 2) = -Q_{5\text{-}2}/Q_2 = -36/62$

$A_d(6, 4) = -Q_{6\text{-}4}/Q_4 = -60/104$

$A_d(7, 3) = -Q_{7\text{-}3}/Q_3 = -40/100$

$A_d(8, 3) = -Q_{8\text{-}3}/Q_3 = -60/100$

$A_d(9, 4) = -Q_{9\text{-}4}/Q_4 = -44/104$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & -\frac{26}{44} \\ 0 & 1 & 0 & 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & -\frac{24}{40} & 0 & 0 \\ -\frac{5}{130} & -\frac{36}{62} & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -\frac{60}{104} & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & -\frac{40}{100} & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & -\frac{60}{100} & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -\frac{44}{104} & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} Q_1 \\ Q_2 \\ Q_3 \\ Q_4 \\ Q_5 \\ Q_6 \\ Q_7 \\ Q_8 \\ Q_9 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ Q_{L3}=100 \\ Q_{L4}=80 \\ 0 \\ Q_{L6}=2 \\ 0 \\ Q_{L8}=44 \\ 0 \end{bmatrix}$$

$$[A_d] = \begin{bmatrix} 1.0000 & 0 & 0 & 0 & 0 & 0 & 0 & -1.0000 & -0.5909 \\ 0 & 1.0000 & 0 & 0 & 0 & -1.0000 & 0 & 0 & 0 \\ 0 & 0 & 1.0000 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1.0000 & 0 & 0 & -0.6000 & 0 & 0 \\ -0.0385 & -0.5806 & 0 & 0 & 1.0000 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -0.5769 & 0 & 1.0000 & 0 & 0 & 0 \\ 0 & 0 & -0.4000 & 0 & 0 & 0 & 1.0000 & 0 & 0 \\ 0 & 0 & -0.6000 & 0 & 0 & 0 & 0 & 1.0000 & 0 \\ 0 & 0 & 0 & -0.4230 & 0 & 0 & 0 & 0 & 1.0000 \end{bmatrix}$$

$$[A_d]^{-1} = \begin{bmatrix} 1.0000 & 0 & 0.6600 & 0.2500 & 0 & 0 & 0.1500 & 1.0000 & 0.5909 \\ 0 & 1.0000 & 0.1385 & 0.5769 & 0 & 1.0000 & 0.3461 & 0 & 0 \\ 0 & 0 & 1.0000 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0.2400 & 1.0000 & 0 & 0 & 0.6000 & 0 & 0 \\ 0.0385 & 0.5806 & 0.1058 & 0.3446 & 1.0000 & 0.5806 & 0.2067 & 0.0385 & 0.0227 \\ 0 & 0 & 0.1385 & 0.5769 & 0 & 1.0000 & 0.3461 & 0 & 0 \\ 0 & 0 & 0.4000 & 0 & 0 & 0 & 1.0000 & 0 & 0 \\ 0 & 0 & 0.6000 & 0 & 0 & 0 & 0 & 1.0000 & 0 \\ 0 & 0 & 0.1015 & 0.4230 & 0 & 0 & 0.2538 & 0 & 1.0000 \end{bmatrix}$$

Using $(Q_{j\text{-}i}/Q_i)[A_d^{-1}]_{ik}\, Q_{Lk}$ contribution of inflow power $Q_{j\text{-}i}$ to the k^{th} load can be calculated. The results are shown in **Table 11** below:

Table 11: Contribution of inflow powers to the load powers

Line j-i	To Q_{L3}	To Q_{L4}	To Q_{L6}	To Q_{L8}	Total inflow
1,8	1×0.6×100 =60	1×0=0	1×0=0	1×1×44 =44	**104**
1,9	26/44×0.1015×100 =6	26/44×0.423×80 =20	26/44×0=0	26/44×0 =0	**25.98**
2,6	62/62×0.1385×100 =13.85	62/62×0.5769×80 =46.125	62/62×1×2 =2	62/62×0 =0	**62.002**
4,7	24/40×0.4×100 =24	24/40×0 =0	24/40×0 =0	24/40×0 =0	**24**
5,1	5/130×0.66×100 =2.538	5/130×0.25×80 =0.7692	5/130×0=0	5/130×1×44 =1.6923	**4.999**
5,2	36/62×0.1385×100 =8.041	36/62×0.5769×80 =26.7979	36/62×1×2 =1.1613	36/62 ×0 =0	**36.0001**
6,4	60/104×0.24×100 =13.846	60/104×1×80 =46.153	60/104×0 =0	60/104×0 =0	**59.999**
7,3	40/100×1×100 =40	40/100×0 =0	40/100×0 =0	40/100×0 =0	**40**
8,3	60/100×1×100 =60	60/100×0 =0	60/100×0 =0	60/100×0 =0	**60**
9,4	44/104×0.24×100 =10.1538	44/104×1×80 =33.846	44/104×0 =0	44/104×0 =0	**43.999**

Using $(Q_{Gi}/Q_i)[A_d^{-1}]_{ik}\, Q_{Lk,}$ contribution of generators power Q_{Gi} to the kth load can be calculated. The results are shown in **Table 12** below:

Table 12: Contribution of generator powers to the loads

Generator	To Q_{L3}	To Q_{L4}	To Q_{L6}	To Q_{L8}	Total Generation
Q_{G1}	125/130×0.6600×100 = 63.4615	125/130×0.2500×80 =19.2308	125/130×0×2 = 0	125/130×1×44 = 42.3076	**124.9998**
Q_{G2}	26/62×0.1385×100 = 5.808	26/62×0.5769 ×80 =19.3540	26/62×1×2= 0.8387	26/62×0×44 = 0	**26.0007**
Q_{S5}	41/41×0.1058×100 = 10.58	41/41×0.3446×80 =27.568	41/41×0.5806×2 =1.1612	41/41×0.0385 ×44 = 1.694	**41.004**
Q_{S7}	16/40×0.4000 ×100 = 16	16/40×0 ×80 = 0	16/40×0 ×2 = 0	16/40×0×44 = 0	**16**
Q_{S9}	18/44×0.1015×100= 4.1522	18/44×0.4230×80= 13.8462	18/44×0×2=0	18/44×0×44= 0	**17.9958**
Total	**100.00017**	**79.9963**	**1.9999**	**44.0017**	

Downstream-looking algorithm will enable us to compute the contribution of inflow powers in the lines to the individual loads. Further, it is possible to find out the contribution of different generators and fictitious sources to the different loads.

4.8 Results Of Down-Stream Looking Algorithm For Reactive Power From Appendix D

Contribution Of Inflow Powers To The Load Power (3) =

0	0	0	0	0	0	0	60.0000	6.0000
0	0	0	0	0	13.8462	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	24.0000	0	0
2.5385	8.0397	0	0	0	0	0	0	0
0	0	0	13.8462	0	0	0	0	0
0	0	40.0000	0	0	0	0	0	0
0	0	60.0000	0	0	0	0	0	0
0	0	0	10.1538	0	0	0	0	0

Contribution Of Inflow Powers To The Load Power (4) =

0	0	0	0	0	0	0	0	20.0000
0	0	0	0	0	46.1538	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0.7692	26.7990	0	0	0	0	0	0	0
0	0	0	46.1538	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	33.8462	0	0	0	0	0

Contribution Of Inflow Powers To The Load Power (6) =

0	0	0	0	0	0	0	0	0
0	0	0	0	0	2.0000	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	1.1613	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0

Contribution Of Inflow Powers To The Load Power (8) =

0	0	0	0	0	0	0	44.0000	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
1.6923	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0

QG (1) To Load Power (3) = 63.4615

QG (1) To Load Power (4) = 19.2308

QG (1) To Load Power (6) = 0

QG (1) To Load Power (8) = 42.3077

QG (2) To Load Power (3) = 5.8065

QG (2) To Load Power (4) = 19.3548

QG (2) To Load Power (6) = 0.8387

QG (2) To Load Power (8) = 0

QS (5) To Load Power (3) = 10.5782

QS (5) To Load Power (4) = 27.5682

QS (5) To Load Power (6) = 1.1613

QS (5) To Load Power (8) = 1.6923

QS (7) To Load Power (3) = 16.0000

QS (7) To Load Power (4) = 0

QS (7) To Load Power (6) = 0

QS (7) To Load Power (8) = 0

QS (9) To Load Power (3) = 4.1538

QS (9) To Load Power (4) = 13.8462

QS (9) To Load Power (6) = 0

QS (9) To Load Power (8) = 0

Comparing Few Results

% error = (|Your Result - Accepted Value| / Accepted Value) x 100

%error for Line 1-8 To Load 3= [(60-60)/ 60]*100 = 0

%error for Line 1-9 To Load 3= [(6-6)/6]*100 = 0

%error for Line 1-9 To Load 4= [(20-20)/ 20]*100 = 0

%error for Line 2-6To Load 4= [(46.1538-46.125)/ 46.1538]*100 = 0.00062

%error for Line 2-6 To Load 6= [(2-2)/ 2]*100 = 0

%error for Line 5-2 To Load 6= [(1.1613-1.1613)/ 1.1613]*100 = 0

%error for Line 1-8To Load 8= [(44-44)/ 44]*100 = 0

%error for Line 5-2 To Load 8= [(1.6923-1.6923-)/ 1.6923-]*100 = 0

%error for Load 3 From GEN 1= [(63.4615-63.4615)/ 63.4615]*100 = 0

%error for Load 4 From GEN 1= [(19.2308-19.2308)/ 19.2308]*100 = 0

%error for Load 3 From GEN 7= [(16-16)/ 16]*100 = 0

%error for Load 3 From GEN 9= [(4.1538-4.1522)/ 4.1538]*100 =0.038

%error for Load 4 From GEN 9= [(13.8462-13.8462)/ 13.8462]*100 = 0

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

First the energy was regulated with government, whatever they fixed the price that was a price and that time government was only source. In a regulated area one company or government agency that produced, transmitted and sold electric power and services and there was no choice then new concept came in early 90's to encourage competition. Continuing the trend towards the deregulation and unbundling of transmission services has resulted in the need to assess what is the impact of particular generator or the load on the power system. So the advantages of the tracing the flow of electricity in meshed electrical networks has been proposed which can be applied to both real and reactive power flows. This method is of topological nature and works on the results of load flow program or a state estimation program. Tracing the flow of electricity make it possible to charge the suppliers and/or generators for estimated amount of losses caused and hence it will encourage efficiency of individual generators in order to decrease the losses. It allows the assess that how much of the real and reactive power out from a particular station goes to a particular load and also tells us about the contribution of individual generators (or loads) to individual line flows.

5.2 Recommendation

Future research will focus on the design of MATLAB toolbox for the required system as well for the larger system of tracing the flow of electricity. Through which we can get the calculation or contribution of both real and reactive power which can trace the line flow and load contribution.

REFERENCES

[1]. Bialek, J., "Tracing the flow of electricity", IEE Proceedings-Generation, Transmission and Distribution, Vol.143, No. 4, July 1996, pp.313-320

[2]. l.l.lai 'Power System Restructuring and Deregulation',Yale Journal of regulation,vol.9,1997, pp.10-45.

[3]. M.C.hoffman,'The future of electricity provision',Tegulation, vol.3,1994, pp.55-66

[4]. 'An introduction to pool rule'. The electricity Pool of England and Wales, Prepared March 1991,updated Deomber1991 and April 1993, p. 3

[5]. Saadat H., 2004, "Power System Analysis", 2nd Ed., Singapore, McGraw Hill, Pp.163

[6]. Acha, R.Fuerte-Esquivel, Ambriz-Perez, Angeles-Camacho, 2004, "FACTS Modelling and Simulation in Power Networks", New York, John Wiley & Sons, Pp.33-38.

[7]. A. Kazemi, H. Andami, IEEE, 2004, IEEE International Conference on Electric Utility Deregulation, Restructuring and Power Technologies, Hong Kong

[8]. Gyugyi, L., "Unified power-flow control concept for flexible AC transmission systems", Generation, Transmission and Distribution, IEE Proceedings C, Volume 139, Issue 4, July 1992 Page(s):323 – 331

[9]. A. F. Glimm and G. W. Stagg, "Automatic Calculation of Load Flows", AIEE Transaction (Power Apparatus and Systems), vol. 76, pp. 817-828, October 1957.

[10]. D. Kirschen, R. Allan, G. Strbac "Contributions of Individual Generators to Loads and Flows," IEEE Transaction on Power Systems, vol. 12, pp. 1312-1319, February 1997.

[11]. Schweppe, F.C., Caramanis, M.C., Tabors, R.D., and Bohn, R.E.: 'Spot pricing of electricity', (Kluwer, Boston, 1988).

APPENDICES

APPENDIX A

UP-STREAM LOOKING ALGORITHM FOR ACTIVE POWER

```
% Bus Powers
 Pbus(1:4)=[394.5;172;304;285.5];

 %Generators Power
 PG(1:2)=[394.5;112.5];

 %Line Powers
 P(1,2)=59.5;
 P(1,3)=221.5;
 P(4,3)=82.5;
 P(1,4)=113.5;
 P(2,4)=172;

 %Matrix Generated From Line Powers and Bus Powers
 Au(1,1)=1;
 Au(2,2)=1;
 Au(3,3)=1;
 Au(4,4)=1;
 Au(2,1)=-P(1,2)/Pbus(1);
 Au(3,1)=-P(1,3)/Pbus(1);
 Au(3,4)=-P(4,3)/Pbus(4);
 Au(4,1)=-P(1,4)/Pbus(1);
 Au(4,2)=-P(2,4)/Pbus(2);

 %Inverse of Generated Matrix
 Au

 Auinv=inv(Au)

 %Contribution of Generators For Outflow Powers

 %From Generator 1
 PL1to2FromGEN1=[P(1,2)/Pbus(1)]*Auinv(1,1)*PG(1);
 PL1to3FromGEN1=[P(1,3)/Pbus(1)]*Auinv(1,1)*PG(1);
 PL1to4FromGEN1=[P(1,4)/Pbus(1)]*Auinv(1,1)*PG(1);
 PL2to4FromGEN1=[P(2,4)/Pbus(2)]*Auinv(2,1)*PG(1);
 PL4to3FromGEN1=[P(4,3)/Pbus(4)]*Auinv(4,1)*PG(1);
```

```
PlineFromGEN1=[PL1to2FromGEN1,PL1to3FromGEN1,PL1to4FromGEN1,
PL2to4FromGEN1,PL4to3FromGEN1]

%From Generator 2
PL1to2FromGEN2=[P(1,2)/Pbus(1)]*Auinv(1,2)*PG(2);
PL1to3FromGEN2=[P(1,3)/Pbus(1)]*Auinv(1,2)*PG(2);
PL1to4FromGEN2=[P(1,4)/Pbus(1)]*Auinv(1,2)*PG(2);
PL2to4FromGEN2=[P(2,4)/Pbus(2)]*Auinv(2,2)*PG(2);
PL4to3FromGEN2=[P(4,3)/Pbus(4)]*Auinv(4,2)*PG(2);

PlineFromGEN2=[PL1to2FromGEN2,PL1to3FromGEN2,PL1to4FromGEN2,
PL2to4FromGEN2,PL4to3FromGEN2]

%Contribution of Generators to meet the Load Powers
PLoad(1:4)=[1;1;304;203];
PLoad3FromGEN1=[PLoad(3)/Pbus(3)]*Auinv(3,1)*PG(1);
PLoad4FromGEN1=[PLoad(4)/Pbus(4)]*Auinv(4,1)*PG(1);
PLoad3FromGEN2=[PLoad(3)/Pbus(3)]*Auinv(3,2)*PG(2);
PLoad4FromGEN2=[PLoad(4)/Pbus(4)]*Auinv(4,2)*PG(2);

GeneratorsContributionForLoadPowers=[PLoad3FromGEN1,
PLoad4FromGEN1, PLoad3FromGEN2, PLoad4FromGEN2]
```

APPENDIX B

DOWN-STREAM LOOKING ALGORITHM FOR ACTIVE POWER

```
%DOWNSTREAM -LOOKING ALGORITHM FOR ACTIVE POWER
%Matrix Generated From Line Powers and Bus Powers
 Ad(1,1)=1;
 Ad(2,2)=1;
 Ad(3,3)=1;
 Ad(4,4)=1;
 Ad(1,2)=-P(1,2)/Pbus(2);
 Ad(1,3)=-P(1,3)/Pbus(3);
 Ad(1,4)=-P(1,4)/Pbus(4);
 Ad(2,4)=-P(2,4)/Pbus(4);
 Ad(4,3)=-P(4,3)/Pbus(3);

%Inverse of Generated Matrix
Ad

Adinv=inv(Ad)

%Contribution of Inflow powers to the load powers

%To Load Power 3
PLoad(1:4)=[1;1;304;203];

PL1to2ToLoadPower3=[P(1,2)/Pbus(2)]*Adinv(2,3)*PLoad(3);
PL1to3ToLoadPower3=[P(1,3)/Pbus(3)]*Adinv(3,3)*PLoad(3);
PL1to4ToLoadPower3=[P(1,4)/Pbus(4)]*Adinv(4,3)*PLoad(3);
PL2to4ToLoadPower3=[P(2,4)/Pbus(4)]*Adinv(4,3)*PLoad(3);
PL4to3ToLoadPower3=[P(4,3)/Pbus(3)]*Adinv(3,3)*PLoad(3);

ContributionOfInflowPowerToLoadPower3=[PL1to2ToLoadPower3,
PL1to3ToLoadPower3, PL1to4ToLoadPower3, PL2to4ToLoadPower3,
PL4to3ToLoadPower3]
%To Load Power 4
PL1to2ToLoadPower4=[P(1,2)/Pbus(2)]*Adinv(2,4)*PLoad(4);
PL1to3ToLoadPower4=[P(1,3)/Pbus(3)]*Adinv(3,4)*PLoad(4);
PL1to4ToLoadPower4=[P(1,4)/Pbus(4)]*Adinv(4,4)*PLoad(4);
PL2to4ToLoadPower4=[P(2,4)/Pbus(4)]*Adinv(4,4)*PLoad(4);
PL4to3ToLoadPower4=[P(4,3)/Pbus(3)]*Adinv(3,4)*PLoad(4);

ContributionOfInflowPowerToLoadPower4=[PL1to2ToLoadPower4,PL
1to3ToLoadPower4,PL1to4ToLoadPower4,PL2to4ToLoadPower4,PL4to
3ToLoadPower4]
```

```
%Contribution of Generator Powers To the Loads
ContributionofPGen1toPLoad3=[PG(1)/Pbus(1)]*Adinv(1,3)*PLoad
(3);
ContributionofPGen2toPLoad4=[P(G2)/Pbus(2)]*Adinv(2,4)*PLoad
(4);

ContributionofPGENtoPLoads=[ContributionofPGen1toPLoad3,Cont
ributionofPGen2toPLoad4]
```

APPENDIX C

IMPROVED PROGRAMMING OF UP-STREAM & DOWN-STREAM LOOKING ALGORITHM FOR 4 BUS ACTIVE POWER

```
%UPSTREAM-LOOKING ALGORITHM

% Bus Powers
 Pbus(1:4)=[394.5;172;304;285.5];
 PLoad(1:4)=[0;0;304;203];

 %Generators Power
 PG(1:2)=[394.5;112.5];

 %Line Powers
 P(1,2)=59.5;
 P(1,3)=221.5;
 P(4,3)=82.5;
 P(1,4)=113.5;
 P(2,4)=172;

 %Matrix Generated From Line Powers and Bus Powers


 for m=1:4
    for n=1:4
 Au(m,n)=-P(n,m)/Pbus(n);
 Au(1,1)=1;
 Au(2,2)=1;
 Au(3,3)=1;
 Au(4,4)=1;
 end
end




 %Inverse of Generated Matrix
 Au

 Auinv=inv(Au)

 %Contribution of Generators For Outflow Powers
```

```
%From Generator 1
for m=1:4
   for n=1:4

ContributionOfGenerator1ForOutflowPowersForLine(m,n)=[P(m,n)
/Pbus(m)]*Auinv(m,1)*PG(1);
  end
end
ContributionOfGenerator1ForOutflowPowersForLine


%PlineFromGEN1=[PL1to2FromGEN1,PL1to3FromGEN1,PL1to4FromGEN1
,PL2to4FromGEN1,PL4to3FromGEN1]

%From Generator 2
for m=1:4
   for n=1:4

ContributionOfGenerator2ForOutflowPowersForLine(m,n)=[P(m,n)
/Pbus(m)]*Auinv(m,2)*PG(2);
  end
end
ContributionOfGenerator2ForOutflowPowersForLine


%Contribution of Generators to meet the Load Powers
PLoad(1:4)=[0;0;304;203];

% m is Load no: and n is Generator no:
for m=3
    for n=1
  PLoad3FromGEN1=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad3FromGEN1


 % m is Load no: and n is Generator no:
 for m=4
    for n=1
  PLoad4FromGEN1=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad4FromGEN1


 % m is Load no: and n is Generator no:
```

```
for m=3
   for n=2
 PLoad3FromGEN2=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
   end
end
PLoad3FromGEN2


% m is Load no: and n is Generator no:
for m=4
   for n=2
 PLoad4FromGEN2=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
   end
end
PLoad4FromGEN2

%---------------------------------------------------------

%DOWNSTREAM-LOOKING ALGORITHM

for m=1:4
   for n=1:4
Ad(m,n)=-P(m,n)/Pbus(n);
Ad(1,1)=1;
Ad(2,2)=1;
Ad(3,3)=1;
Ad(4,4)=1;
end
 end

 Ad

 Adinv=inv(Ad)
 %Contribution of inflow Powers to the load Powers

 %For Load 3
 for m=1:4
   for n=1:4

ContributionOfInflowPowersToTheLoadPower3(m,n)=[P(m,n)/Pbus(
n)]*Adinv(n,3)*PLoad(3);
 end
 end
 ContributionOfInflowPowersToTheLoadPower3

 %For Load 4
for m=1:4
```

```
    for n=1:4
ContributionOfInflowPowersToTheLoadPower4(m,n)=[P(m,n)/Pbus(
n)]*Adinv(n,4)*PLoad(4);
  end
  end
  ContributionOfInflowPowersToTheLoadPower4


  %Contribution of generators powers to the loads
  %From Generator 1 To Load 3
  for m=1
    for n=3
   PG1ToLoadPower3=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG1ToLoadPower3

 %From Generator 1 To Load 4
 for m=1
    for n=4
   PG1ToLoadPower4=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG1ToLoadPower4

 % From Generator 2 To Load 3
 for m=2
    for n=3
   PG2ToLoadPower3=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG2ToLoadPower3

 %From Generator 2 To Load 4
 for m=2
    for n=4
   PG2ToLoadPower4=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
 end
   PG2ToLoadPower4
```

APPENDIX D

IMPROVED PROGRAMMING OF UP-STREAM & DOWN-STREAM LOOKING ALGORITHM FROM 4 BUS FOR REACTIVE POWER

```
Bus Powers
 Qbus(1:9)=[130;62;100;104;41;62;40;104;44];
 %-----------------------------------------------------------
 Load
 QLoad(1:9)=[0;0;100;80;0;2;0;44;0];
%------------------------------------------------------------

 %Generators Power
 QG(1:2)=[125;26];
 %-----------------------------------------------------------

 %Source Power
 QS(1:9)=[0;0;0;0;41;0;16;0;18];

 %-----------------------------------------------------------
 %-----------------------------------------------------------
 %UPSTREAM-LOOKING ALGORITHM
 %-----------------------------------------------------------
 %Line Powers
 Q(1,8)=104;
 Q(1,9)=26;
 Q(2,6)=62;
 Q(4,7)=24;
 Q(5,1)=5;
 Q(5,2)=36;
 Q(6,4)=60;
 Q(7,3)=40;
 Q(8,3)=60;
 Q(9,4)=44;


%------------------------------------------------------------

 %Matrix Generated From Line Powers and Bus Powers


 for m=1:9
    for n=1:9
 Au(m,n)=-Q(n,m)/Qbus(n);
```

```
 Au(1,1)=1;
 Au(2,2)=1;
 Au(3,3)=1;
 Au(4,4)=1;
 Au(5,5)=1;
 Au(6,6)=1;
 Au(7,7)=1;
 Au(8,8)=1;
 Au(9,9)=1;
 end
end

 %Inverse of Generated Matrix
 Au

 Auinv=inv(Au)

 %Contribution of Generators For Outflow Powers
 %-----------------------------------------------------------


 %From Generator 1
 for m=1:9
    for n=1:9

ContributionOfGenerator1ForOutflowPowersForLine(m,n)=[Q(m,n)
/Qbus(m)]*Auinv(m,1)*QG(1);
  end
 end
 ContributionOfGenerator1ForOutflowPowersForLine

%------------------------------------------------------------

%From Generator 2
 for m=1:9
    for n=1:9

ContributionOfGenerator2ForOutflowPowersForLine(m,n)=[Q(m,n)
/Qbus(m)]*Auinv(m,2)*QG(2);
  end
 end
ContributionOfGenerator2ForOutflowPowersForLine
%------------------------------------------------------------

%From Source Of Bus 5
 for m=1:9
    for n=1:9
```

```
ContributionOfSource5ForOutflowPowersForLine(m,n)=[Q(m,n)/Qb
us(m)]*Auinv(m,5)*QS(5);
  end
 end
ContributionOfSource5ForOutflowPowersForLine
%-------------------------------------------------------------

%From Source Of Bus 7
 for m=1:9
    for n=1:9

ContributionOfSource7ForOutflowPowersForLine(m,n)=[Q(m,n)/Qb
us(m)]*Auinv(m,7)*QS(7);
  end
 end
ContributionOfSource7ForOutflowPowersForLine
%-------------------------------------------------------------

%From Source Of Bus 9
 for m=1:9
    for n=1:9

ContributionOfSource9ForOutflowPowersForLine(m,n)=[Q(m,n)/Qb
us(m)]*Auinv(m,9)*QS(9);
  end
 end
ContributionOfSource9ForOutflowPowersForLine


%Contribution of Generators to meet the Load Powers
%-------------------------------------------------------------

% m is Load no: and n is Generator no:
for m=3
    for n=1
  QLoad3FromGEN1=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad3FromGEN1


 % m is Load no: and n is Generator no:
 for m=4
    for n=1
  QLoad4FromGEN1=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
```

```
end
 QLoad4FromGEN1

 % m is Load no: and n is Generator no:
 for m=6
    for n=1
  QLoad6FromGEN1=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad6FromGEN1

 % m is Load no: and n is Generator no:
 for m=8
    for n=1
  QLoad8FromGEN1=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad8FromGEN1

 %----------------------------------------------------------

 % m is Load no: and n is Generator no:
 for m=3
    for n=2
  QLoad3FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad3FromGEN2


 % m is Load no: and n is Generator no:
 for m=4
    for n=2
  QLoad4FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
QLoad4FromGEN2

  % m is Load no: and n is Generator no:
 for m=6
    for n=2
 QLoad6FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad6FromGEN2

 % m is Load no: and n is Generator no:
```

```
for m=8
   for n=2
 QLoad8FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
   end
end
 QLoad8FromGEN2

%-----------------------------------------------------------

% m is Load no: and n is Generator no:
for m=3
   for n=5
 QLoad3FromSource5=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QS(n);
   end
end
 QLoad3FromSource5


% m is Load no: and n is Generator no:
for m=4
   for n=5
 QLoad4FromSource5=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QS(n);
   end
end
 QLoad4FromSource5

  % m is Load no: and n is Generator no:
for m=6
   for n=5
 QLoad6FromSource5=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QS(n);
   end
end
 QLoad6FromSource5

% m is Load no: and n is Generator no:
for m=8
   for n=5
 QLoad8FromSource5=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QS(n);
   end
end
 QLoad8FromSource5

%-----------------------------------------------------------

% m is Load no: and n is Generator no:
for m=3
   for n=7
```

```
  QLoad3FromSource7=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QS(n);
    end
end
 QLoad3FromSource7

 % m is Load no: and n is Generator no:
 for m=4
    for n=7
  QLoad4FromSource7=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QS(n);
    end
end
 QLoad4FromSource7

  % m is Load no: and n is Generator no:
 for m=6
    for n=7
  QLoad6FromSource7=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QS(n);
    end
end
 QLoad6FromSource7

 % m is Load no: and n is Generator no:
 for m=8
    for n=7
  QLoad8FromSource7=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QS(n);
    end
end
 QLoad8FromSource7

 %-----------------------------------------------------------

 % m is Load no: and n is Generator no:
 for m=3
    for n=9
  QLoad3FromSource9=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QS(n);
    end
end
 QLoad3FromSource9


 % m is Load no: and n is Generator no:
 for m=4
    for n=9
  QLoad4FromSource9=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QS(n);
    end
end
 QLoad4FromSource9
```

```
 % m is Load no: and n is Generator no:
for m=6
   for n=9
 QLoad6FromSource9=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QS(n);
   end
end
QLoad6FromSource9

% m is Load no: and n is Generator no:
for m=8
   for n=9
 QLoad8FromSource9=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QS(n);
   end
end
QLoad8FromSource9


%-----------------------------------------------------------
%DOWNSTREAM-LOOKING ALGORITHM
%-----------------------------------------------------------

 for m=1:9
   for n=1:9
Ad(m,n)=-Q(m,n)/Qbus(n);
Ad(1,1)=1;
Ad(2,2)=1;
Ad(3,3)=1;
Ad(4,4)=1;
Ad(5,5)=1;
Ad(6,6)=1;
Ad(7,7)=1;
Ad(8,8)=1;
Ad(9,9)=1;
 end
end

 Ad

 Adinv=inv(Ad)



 %-----------------------------------------------------------
 %Contribution of inflow Powers to the load Powers
```

```
%-----------------------------------------------------------

%For Load 3
for m=1:9
  for n=1:9

ContributionOfInflowPowersToTheLoadPower3(m,n)=[Q(m,n)/Qbus(
n)]*Adinv(n,3)*QLoad(3);
   end
  end
  ContributionOfInflowPowersToTheLoadPower3
%-----------------------------------------------------------

 %For Load 4
for m=1:9
   for n=1:9

ContributionOfInflowPowersToTheLoadPower4(m,n)=[Q(m,n)/Qbus(
n)]*Adinv(n,4)*QLoad(4);
   end
  end
  ContributionOfInflowPowersToTheLoadPower4
  %----------------------------------------------------------


   %For Load 6
for m=1:9
   for n=1:9

ContributionOfInflowPowersToTheLoadPower6(m,n)=[Q(m,n)/Qbus(
n)]*Adinv(n,6)*QLoad(6);
   end
  end
  ContributionOfInflowPowersToTheLoadPower6
  %----------------------------------------------------------

   %For Load 8
for m=1:9
   for n=1:9

ContributionOfInflowPowersToTheLoadPower8(m,n)=[Q(m,n)/Qbus(
n)]*Adinv(n,8)*QLoad(8);
   end
  end
  ContributionOfInflowPowersToTheLoadPower8
  %----------------------------------------------------------
```

```
%Contribution of generators powers to the loads
%------------------------------------------------------------

%From Generator 1 To Load 3
for m=1
   for n=3
 QG1ToLoadPower3=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
   end
end
 QG1ToLoadPower3

 %From Generator 1 To Load 4
  for m=1
    for n=4
  QG1ToLoadPower3=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG1ToLoadPower3

 %From Generator 1 To Load 6
  for m=1
    for n=6
  QG1ToLoadPower6=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG1ToLoadPower6

 %From Generator 1 To Load 8
 for m=1
    for n=8
  QG1ToLoadPower8=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG1ToLoadPower8
%--------------------------------------------------------------

 % From Generator 2 To Load 3
 for m=2
    for n=3
  QG2ToLoadPower3=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG2ToLoadPower3

  % From Generator 2 To Load 3
 for m=2
```

```
    for n=4
  QG2ToLoadPower4=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG2ToLoadPower4

  % From Generator 2 To Load 3
 for m=2
    for n=6
  QG2ToLoadPower6=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG2ToLoadPower6


 %From Generator 2 To Load 4
 for m=2
    for n=8
  QG2ToLoadPower8=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
 end
  QG2ToLoadPower8
 %-----------------------------------------------------------

% From Source bus 5 To Load 3
 for m=5
    for n=3
  QS5ToLoadPower3=[QS(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QS5ToLoadPower3

  % From Generator 2 To Load 3
 for m=5
    for n=4
  QS5ToLoadPower4=[QS(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QS5ToLoadPower4

  % From Generator 2 To Load 3
 for m=5
    for n=6
  QS5ToLoadPower6=[QS(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QS5ToLoadPower6
```

```
%From Generator 2 To Load 4
for m=5
   for n=8
  QS5ToLoadPower8=[QS(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
   end
end
  QS5ToLoadPower8
  %-----------------------------------------------------------
% From Source bus 5 To Load 3
for m=7
   for n=3
  QS7ToLoadPower3=[QS(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
   end
end
QS7ToLoadPower3

 % From Generator 2 To Load 3
for m=7
   for n=4
  QS7ToLoadPower4=[QS(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
   end
end
QS7ToLoadPower4

 % From Generator 2 To Load 3
for m=7
   for n=6
  QS7ToLoadPower6=[QS(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
   end
end
QS7ToLoadPower6


%From Generator 2 To Load 4
for m=7
   for n=8
  QS7ToLoadPower8=[QS(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
   end
end
  QS7ToLoadPower8
  %-----------------------------------------------------------

  % From Source bus 5 To Load 3
for m=9
   for n=3
```

```
    QS9ToLoadPower3=[QS(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
     end
end
 QS9ToLoadPower3

  % From Generator 2 To Load 3
 for m=9
    for n=4
   QS9ToLoadPower4=[QS(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QS9ToLoadPower4

  % From Generator 2 To Load 3
 for m=9
    for n=6
   QS9ToLoadPower6=[QS(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QS9ToLoadPower6


 %From Generator 2 To Load 4
 for m=9
    for n=8
   QS9ToLoadPower8=[QS(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
  QS9ToLoadPower8
  %-------------------------------------------------------------
```

APPENDIX E

UP-STREAM & DOWN-STREAM LOOKING ALGORITHM FOR 9 BUS ACTIVE POWER

```
%UPSTREAM-LOOKING ALGORITHM

% Bus Powers

Pbus(1:9)=[71.735;161.515;83.23;71.735;90.81;84.23;100.305;1
61.515;126.365];
 PLoad(1:9)=[0;0;0;0;90.81;0;100.305;0;126.365];

 %Generators Power
 PG(1:3)=[71.735;161.515;83.23];

 %Line Powers
 P(1,4)=71.735;
 P(2,8)=161.515;
 P(3,6)=84.23;
 P(4,5)=30.64;
 P(4,9)=41.095;
 P(6,5)=60.17;
 P(6,7)=24.06;
 P(8,7)=76.245;
 P(8,9)=85.27;



 %Matrix Generated From Line Powers and Bus Powers


 for m=1:9
    for n=1:8
 Au(m,n)=-P(n,m)/Pbus(n);
 Au(1,1)=1;
 Au(2,2)=1;
 Au(3,3)=1;
 Au(4,4)=1;
 Au(5,5)=1;
 Au(6,6)=1;
 Au(7,7)=1;
 Au(8,8)=1;
 Au(9,9)=1;

 end
end


 %Inverse of Generated Matrix
 Au;
```

```
Auinv=inv(Au)


%-----Contribution of Generators For Outflow Powers---

%From Generator 1
for m=1:8
   for n=1:9

ContributionOfGenerator1ForOutflowPowersForLine(m,n)=[P(m,n)
/Pbus(m)]*Auinv(m,1)*PG(1);
  end
end
ContributionOfGenerator1ForOutflowPowersForLine



%From Generator 2
for m=1:8
   for n=1:9

ContributionOfGenerator2ForOutflowPowersForLine(m,n)=[P(m,n)
/Pbus(m)]*Auinv(m,2)*PG(2);
  end
end
ContributionOfGenerator2ForOutflowPowersForLine


%From Generator 3
for m=1:8
   for n=1:9

ContributionOfGenerator3ForOutflowPowersForLine(m,n)=[P(m,n)
/Pbus(m)]*Auinv(m,3)*PG(3);
  end
end
ContributionOfGenerator3ForOutflowPowersForLine




%Contribution of Generators to meet the Load Powers


%----FOR GENERATOR 1------------
% m is Load no: and n is Generator no:
for m=5
    for n=1
  PLoad5FromGEN1=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
PLoad5FromGEN1
```

```
% m is Load no: and n is Generator no:
for m=7
    for n=1
  PLoad7FromGEN1=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad7FromGEN1



 % m is Load no: and n is Generator no:
for m=9
    for n=1
  PLoad9FromGEN1=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad9FromGEN1


 %----FOR GENERATOR 2-------------

 % m is Load no: and n is Generator no:
for m=5
    for n=2
  PLoad5FromGEN2=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad5FromGEN2


 % m is Load no: and n is Generator no:
for m=7
    for n=2
  PLoad7FromGEN2=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad7FromGEN2



 % m is Load no: and n is Generator no:
for m=9
    for n=2
  PLoad9FromGEN2=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad9FromGEN2
```

```
%----FOR GENERATOR 32------------

 % m is Load no: and n is Generator no:
for m=5
    for n=3
  PLoad5FromGEN3=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad5FromGEN3


 % m is Load no: and n is Generator no:
for m=7
    for n=3
  PLoad7FromGEN3=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad7FromGEN3



 % m is Load no: and n is Generator no:
for m=9
    for n=3
  PLoad9FromGEN3=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad9FromGEN3



%-----------------------------------------------------
 %DOWNSTREAM-LOOKING ALGORITHM
%-----------------------------------------------------
  for m=1:8
    for n=1:9
 Ad(m,n)=-P(m,n)/Pbus(n);
 Ad(1,1)=1;
 Ad(2,2)=1;
 Ad(3,3)=1;
 Ad(4,4)=1;
 Ad(5,5)=1;
 Ad(6,6)=1;
 Ad(7,7)=1;
 Ad(8,8)=1;
 Ad(9,9)=1;

 end
  end

  Ad;
  Adinv=inv(Ad)
```

```
%------------------------------------------------------
%-----Contribution of inflow Powers to the load Powers----

 %For Load 5
   for m=1:8
    for n=1:9

ContributionOfInflowPowersToTheLoadPower5(m,n)=[P(m,n)/Pbus(
n)]*Adinv(n,5)*PLoad(5);
  end
  end
  ContributionOfInflowPowersToTheLoadPower5


  %For Load 7
   for m=1:8
    for n=1:9

ContributionOfInflowPowersToTheLoadPower7(m,n)=[P(m,n)/Pbus(
n)]*Adinv(n,7)*PLoad(7);
  end
  end
  ContributionOfInflowPowersToTheLoadPower7

   %For Load 4
   for m=1:8
    for n=1:9

ContributionOfInflowPowersToTheLoadPower9(m,n)=[P(m,n)/Pbus(
n)]*Adinv(n,9)*PLoad(9);
  end
  end
  ContributionOfInflowPowersToTheLoadPower9



  %--------Contribution of generators powers to the loads---
-----

   %------FOR GENERATOR 1---------
   %From Generator 1 To Load 5
  for m=1
    for n=5
   PG1ToLoadPower5=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG1ToLoadPower5

 %From Generator 1 To Load 7
  for m=1
```

```
    for n=7
   PG1ToLoadPower7=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG1ToLoadPower7


 %From Generator 1 To Load 9
  for m=1
    for n=9
   PG1ToLoadPower9=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG1ToLoadPower9



 %------FOR GENERATOR 2---------
   %From Generator 2 To Load 5
  for m=2
    for n=5
   PG2ToLoadPower5=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG2ToLoadPower5

 %From Generator 2 To Load 7
  for m=2
    for n=7
   PG2ToLoadPower7=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG2ToLoadPower7


 %From Generator 2 To Load 9
  for m=2
    for n=9
   PG2ToLoadPower9=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG2ToLoadPower9



 %------FOR GENERATOR 3---------
   %From Generator 2 To Load 5
  for m=3
    for n=5
   PG3ToLoadPower5=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG3ToLoadPower5
```

```
%From Generator 3 To Load 7
 for m=3
   for n=7
  PG3ToLoadPower7=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
   end
end
 PG3ToLoadPower7


%From Generator 3 To Load 9
 for m=3
   for n=9
  PG3ToLoadPower9=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
   end
end
 PG3ToLoadPower9
```

APPENDIX F

UP-STREAM & DOWN-STREAM LOOKING ALGORITHM FOR 9 BUS REACTIVE POWER

```
% Bus Powers

Qbus(1:13)=[24.07;14.02;40.95;20.57;15.46;40.95;41.45;16.55;
40;24.07;25.72;16.81;16.05];
%-------------------------------------------------------

 QLoad(1:13)=[0;0;0;0;15.46;0;41.45;0;40;3.32;0;0;10];
%-------------------------------------------------------

 %Generators Power
 QG(1:13)=[24.07;14.02;40.95;0;0;0;0;0;0;0;14.38;16.81;0];
 %------------------------------------------------------



 %------------------------------------------------------
 %UPSTREAM-LOOKING ALGORITHM
 %------------------------------------------------------

 %Line Powers
 Q(1,10)=24.07;
 Q(10,4)=20.75;
 Q(4,11)=11.34;
 Q(4,5)=9.41;
 Q(11,9)=25.72;
 Q(13,5)=6.05;
 Q(12,9)=14.28;
 Q(12,8)=2.53;
 Q(2,8)=14.02;
 Q(8,7)=16.55;
 Q(6,13)=16.05;
 Q(3,6)=40.95;
 Q(6,7)=24.90;

%-------------------------------------------------------

 %Matrix Generated From Line Powers and Bus Powers


 for m=1:13
    for n=1:13
 Au(m,n)=-Q(n,m)/Qbus(n);
 Au(1,1)=1;
 Au(2,2)=1;
 Au(3,3)=1;
 Au(4,4)=1;
 Au(5,5)=1;
 Au(6,6)=1;
```

```
 Au(7,7)=1;
 Au(8,8)=1;
 Au(9,9)=1;
 Au(10,10)=1;
 Au(11,11)=1;
 Au(12,12)=1;
 Au(13,13)=1;
 end
end

 %Inverse of Generated Matrix
 Au

 Auinv=inv(Au)



 %------Contribution of Generators For Outflow Powers--
 %---------------------------------------------------


 %From Generator 1
 for m=1:13
    for n=1:13

ContributionOfGenerator1ForOutflowPowersForLine(m,n)=[Q(m,n)
/Qbus(m)]*Auinv(m,1)*QG(1);
  end
 end
 ContributionOfGenerator1ForOutflowPowersForLine


%From Generator 2
 for m=1:13
    for n=1:13

ContributionOfGenerator2ForOutflowPowersForLine(m,n)=[Q(m,n)
/Qbus(m)]*Auinv(m,2)*QG(2);
  end
 end
ContributionOfGenerator2ForOutflowPowersForLine

%From Generator 3
 for m=1:13
    for n=1:13

ContributionOfGenerator3ForOutflowPowersForLine(m,n)=[Q(m,n)
/Qbus(m)]*Auinv(m,3)*QG(3);
  end
 end
ContributionOfGenerator3ForOutflowPowersForLine
```

```
%%From Source Of Bus 11
 for m=1:13
    for n=1:13

ContributionOfGenerator11ForOutflowPowersForLine(m,n)=[Q(m,n
)/Qbus(m)]*Auinv(m,11)*QG(11);
  end
 end
ContributionOfGenerator11ForOutflowPowersForLine

%%From Source Of Bus  12
 for m=1:13
    for n=1:13

ContributionOfGenerator12ForOutflowPowersForLine(m,n)=[Q(m,n
)/Qbus(m)]*Auinv(m,12)*QG(12);
  end
 end
ContributionOfGenerator12ForOutflowPowersForLine




%------Contribution of Generators to meet the Load Powers --
-
%------------------------------------------------------


%=======FROM GENERATOR 1==============
% m is Load no: and n is Generator no:
for m=5
    for n=1
  QLoad5FromGEN1=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad5FromGEN1



 % m is Load no: and n is Generator no:
for m=7
    for n=1
  QLoad7FromGEN1=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad7FromGEN1



 % m is Load no: and n is Generator no:
for m=9
    for n=1
```

```
  QLoad9FromGEN1=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad9FromGEN1

 % m is Load no: and n is Generator no:
for m=10
    for n=1
  QLoad10FromGEN1=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad10FromGEN1

 % m is Load no: and n is Generator no:
for m=13
    for n=1
  QLoad13FromGEN1=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad13FromGEN1



 %=======FROM GENERATOR 2==============
% m is Load no: and n is Generator no:
for m=5
    for n=2
  QLoad5FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad5FromGEN2

 % m is Load no: and n is Generator no:
for m=7
    for n=2
  QLoad7FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad7FromGEN2


 % m is Load no: and n is Generator no:
for m=9
    for n=2
  QLoad9FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad9FromGEN2

 % m is Load no: and n is Generator no:
for m=10
    for n=2
  QLoad10FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
```

```
    end
end
 QLoad10FromGEN2

 % m is Load no: and n is Generator no:
for m=13
    for n=2
  QLoad13FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad13FromGEN2



  %=======FROM GENERATOR 3===============
% m is Load no: and n is Generator no:
for m=5
    for n=3
  QLoad5FromGEN3=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad5FromGEN3

 % m is Load no: and n is Generator no:
for m=7
    for n=3
  QLoad7FromGEN3=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad7FromGEN3


 % m is Load no: and n is Generator no:
for m=9
    for n=3
  QLoad9FromGEN3=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad9FromGEN3

 % m is Load no: and n is Generator no:
for m=10
    for n=3
  QLoad10FromGEN3=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad10FromGEN3

 % m is Load no: and n is Generator no:
for m=13
    for n=3
  QLoad13FromGEN3=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
```

```
end
 QLoad13FromGEN3



  %=======FROM SOURCE POWER 11==============
% m is Load no: and n is Generator no:
for m=5
    for n=11
  QLoad5FromGEN11=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad5FromGEN11

 % m is Load no: and n is Generator no:
for m=7
    for n=11
  QLoad7FromGEN11=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad7FromGEN11


 % m is Load no: and n is Generator no:
for m=9
    for n=11
  QLoad9FromGEN11=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad9FromGEN11

 % m is Load no: and n is Generator no:
for m=10
    for n=11
  QLoad10FromGEN11=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad10FromGEN11

 % m is Load no: and n is Generator no:
for m=13
    for n=11
  QLoad13FromGEN11=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad13FromGEN11



  %=======FROM SOURCE POWER 12==============
% m is Load no: and n is Generator no:
for m=5
    for n=12
```

```
  QLoad5FromGEN12=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad5FromGEN12

 % m is Load no: and n is Generator no:
for m=7
    for n=12
  QLoad7FromGEN12=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad7FromGEN12


 % m is Load no: and n is Generator no:
for m=9
    for n=12
  QLoad9FromGEN12=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad9FromGEN12

 % m is Load no: and n is Generator no:
for m=10
    for n=12
  QLoad10FromGEN12=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad10FromGEN12

 % m is Load no: and n is Generator no:
for m=13
    for n=12
  QLoad13FromGEN12=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad13FromGEN12



 %-----------------------------------------------------
%DOWNSTREAM-LOOKING ALGORITHM
 %-----------------------------------------------------

  for m=1:13
    for n=1:13
 Ad(m,n)=-Q(m,n)/Qbus(n);
 Ad(1,1)=1;
 Ad(2,2)=1;
 Ad(3,3)=1;
 Ad(4,4)=1;
 Ad(5,5)=1;
 Ad(6,6)=1;
```

```
 Ad(7,7)=1;
 Ad(8,8)=1;
 Ad(9,9)=1;
 Ad(10,10)=1;
 Ad(11,11)=1;
 Ad(12,12)=1;
 Ad(13,13)=1;
  end
  end
%Inverse of downstream matrix
  Ad;
    Adinv=inv(Ad)

  %---------------------------------------------------
   %Contribution of inflow Powers to the load Powers
  %---------------------------------------------------

  %For Load 5
  for m=1:13
    for n=1:13

ContributionOfInflowPowersToTheLoadPower5(m,n)=[Q(m,n)/Qbus(
n)]*Adinv(n,5)*QLoad(5);
   end
  end
  ContributionOfInflowPowersToTheLoadPower5


  %For Load 7
  for m=1:13
    for n=1:13

ContributionOfInflowPowersToTheLoadPower7(m,n)=[Q(m,n)/Qbus(
n)]*Adinv(n,7)*QLoad(7);
   end
  end
  ContributionOfInflowPowersToTheLoadPower7



  %For Load 9
  for m=1:13
    for n=1:13

ContributionOfInflowPowersToTheLoadPower9(m,n)=[Q(m,n)/Qbus(
n)]*Adinv(n,9)*QLoad(9);
   end
  end
  ContributionOfInflowPowersToTheLoadPower9


  %For Load 10
  for m=1:13
    for n=1:13
```

```
ContributionOfInflowPowersToTheLoadPower10(m,n)=[Q(m,n)/Qbus
(n)]*Adinv(n,10)*QLoad(10);
    end
  end
  ContributionOfInflowPowersToTheLoadPower10


  %For Load 5
  for m=1:13
    for n=1:13

ContributionOfInflowPowersToTheLoadPower13(m,n)=[Q(m,n)/Qbus
(n)]*Adinv(n,13)*QLoad(13);
    end
  end
  ContributionOfInflowPowersToTheLoadPower13



  %-----------------------------------------------------
  %-------Contribution of generators powers to the  loads---
--
  %-----------------------------------------------------


  %------------------FROM GENRATOR 1------------------

  %From Generator 1 To Load 5
  for m=1
    for n=5
   QG1ToLoadPower5=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG1ToLoadPower5



 %From Generator 1 To Load 7
  for m=1
    for n=7
   QG1ToLoadPower7=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG1ToLoadPower7


 %From Generator 1 To Load 9
  for m=1
    for n=9
   QG1ToLoadPower9=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG1ToLoadPower9
```

```
 %From Generator 1 To Load 10
  for m=1
    for n=10
   QG1ToLoadPower10=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG1ToLoadPower10


 %From Generator 1 To Load 13
  for m=1
    for n=13
   QG1ToLoadPower13=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG1ToLoadPower13


 %------------------FROM GENRATOR 2-------------------


 %From Generator 2 To Load 5
  for m=2
    for n=5
   QG2ToLoadPower5=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG2ToLoadPower5



 %From Generator 2 To Load 7
  for m=2
    for n=7
   QG2ToLoadPower7=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG2ToLoadPower7


 %From Generator 1 To Load 9
  for m=2
    for n=9
   QG2ToLoadPower9=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG2ToLoadPower9

 %From Generator 2 To Load 10
  for m=2
    for n=10
   QG2ToLoadPower10=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
```

```
end
 QG2ToLoadPower10


 %From Generator 2 To Load 13
  for m=2
    for n=13
   QG2ToLoadPower13=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG2ToLoadPower13


  %------------------FROM GENRATOR 3-------------------


 %From Generator 3 To Load 5
  for m=3
    for n=5
   QG3ToLoadPower5=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG3ToLoadPower5



 %From Generator 3 To Load 7
  for m=3
    for n=7
   QG3ToLoadPower7=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG3ToLoadPower7


 %From Generator 1 To Load 9
  for m=3
    for n=9
   QG3ToLoadPower9=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG3ToLoadPower9

 %From Generator 2 To Load 10
  for m=3
    for n=10
   QG3ToLoadPower10=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG3ToLoadPower10


 %From Generator 2 To Load 13
  for m=3
```

```
    for n=13
   QG3ToLoadPower13=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG3ToLoadPower13


  %-----------------FROM GENRATOR 11--------------------


 %From Generator 11 To Load 5
  for m=11
    for n=5
   QG11ToLoadPower5=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG11ToLoadPower5



 %From Generator 11 To Load 7
  for m=11
    for n=7
   QG11ToLoadPower7=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG11ToLoadPower7


 %From Generator 11 To Load 9
  for m=11
    for n=9
   QG11ToLoadPower9=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG11ToLoadPower9

 %From Generator 11 To Load 10
  for m=11
    for n=10
   QG11ToLoadPower10=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG11ToLoadPower10


 %From Generator 11 To Load 13
  for m=11
    for n=13
   QG11ToLoadPower13=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG11ToLoadPower13
```

```
%-------------------FROM GENRATOR 12------------------

 %From Generator 12 To Load 5
  for m=12
    for n=5
   QG12ToLoadPower5=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG12ToLoadPower5



 %From Generator 12 To Load 7
  for m=12
    for n=7
   QG12ToLoadPower7=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG12ToLoadPower7


 %From Generator 12 To Load 9
  for m=12
    for n=9
   QG12ToLoadPower9=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG12ToLoadPower9

 %From Generator 12 To Load 10
  for m=12
    for n=10
   QG12ToLoadPower10=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG12ToLoadPower10


 %From Generator 12 To Load 13
  for m=12
    for n=13
   QG12ToLoadPower13=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG12ToLoadPower13
```

APPENDIX G

UP-STREAM & DOWN-STREAM LOOKING ALGORITHM FOR 14 BUS ACTIVE POWER

```
Pbus(1:14)=[232;197;170;285;116;145;70;43;92;8;8;109;117;58]
;

PLoad(1:14)=[0;0;0;150;11;10;0;43;30;8;4;50;117;18];

PG(1:14)=[232;40;69;0;0;100;0;0;0;0;0;0;0;0];

 P(1,2)=157;
 P(1,5)=75;
 P(2,4)=55;
 P(2,5)=41;
 P(2,3)=101;
 P(3,4)=170;
 P(4,7)=70;
 P(4,9)=65;
 P(5,4)=60;
 P(5,6)=45;
 P(6,11)=8;
 P(6,12)=109;
 P(6,13)=18;
 P(7,9)=27;
 P(7,8)=43;
 P(9,10)=4;
 P(9,14)=58;
 P(11,10)=4;
 P(12,13)=59;
 P(14,13)=40;

  %------DOWNSTREAM-LOOKING ALGORITHM----------
 for m=1:14
    for n=1:14
 Au(m,n)=-P(n,m)/Pbus(n);
 Au(1,1)=1;
 Au(2,2)=1;
 Au(3,3)=1;
 Au(4,4)=1;
 Au(5,5)=1;
 Au(6,6)=1;
 Au(7,7)=1;
 Au(8,8)=1;
 Au(9,9)=1;
 Au(10,10)=1;
 Au(11,11)=1;
 Au(12,12)=1;
 Au(13,13)=1;
```

```
 Au(14,14)=1;

 end
 end
Au;

Auinv=inv(Au)



%From Generator 1
 for m=1:14
    for n=1:14

ContributionOfGenerator1ForOutflowPowersForLine(m,n)=[P(m,n)
/Pbus(m)]*Auinv(m,1)*PG(1);
  end
 end
 ContributionOfGenerator1ForOutflowPowersForLine


%From Generator 2
 for m=1:14
    for n=1:14

ContributionOfGenerator2ForOutflowPowersForLine(m,n)=[P(m,n)
/Pbus(m)]*Auinv(m,2)*PG(2);
  end
 end
ContributionOfGenerator2ForOutflowPowersForLine


%From Generator 3
 for m=1:14
    for n=1:14

ContributionOfGenerator3ForOutflowPowersForLine(m,n)=[P(m,n)
/Pbus(m)]*Auinv(m,3)*PG(3);
  end
 end
ContributionOfGenerator3ForOutflowPowersForLine

%From Generator 6
 for m=1:14
    for n=1:14

ContributionOfGenerator6ForOutflowPowersForLine(m,n)=[P(m,n)
/Pbus(m)]*Auinv(m,6)*PG(6);
  end
 end
ContributionOfGenerator6ForOutflowPowersForLine
```

```
%-----------Contribution of Generators to meet the Load
Powers--------


% m is Load no: and n is Generator no:
for m=4
    for n=1
  PLoad4FromGEN1=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad4FromGEN1

 % m is Load no: and n is Generator no:
for m=5
    for n=1
  PLoad5FromGEN1=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad5FromGEN1

 % m is Load no: and n is Generator no:
for m=6
    for n=1
  PLoad6FromGEN1=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad6FromGEN1


 % m is Load no: and n is Generator no:
for m=8
    for n=1
  PLoad8FromGEN1=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad8FromGEN1


 % m is Load no: and n is Generator no:
for m=9
    for n=1
  PLoad9FromGEN1=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad9FromGEN1


 % m is Load no: and n is Generator no:
for m=10
    for n=1
  PLoad10FromGEN1=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad10FromGEN1
```

```
 % m is Load no: and n is Generator no:
for m=11
    for n=1
  PLoad11FromGEN1=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad11FromGEN1

 % m is Load no: and n is Generator no:
for m=12
    for n=1
  PLoad12FromGEN1=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad12FromGEN1

 % m is Load no: and n is Generator no:
for m=13
    for n=1
  PLoad13FromGEN1=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad13FromGEN1

 % m is Load no: and n is Generator no:
for m=14
    for n=1
  PLoad14FromGEN1=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad14FromGEN1


%-----------------------------------------------------------
%--------------for GENERATOR 2----------------------

% m is Load no: and n is Generator no:
for m=4
    for n=2
  PLoad4FromGEN2=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad4FromGEN2

 % m is Load no: and n is Generator no:
for m=5
    for n=2
  PLoad5FromGEN2=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad5FromGEN2

 % m is Load no: and n is Generator no:
```

```
for m=6
    for n=2
  PLoad6FromGEN2=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad6FromGEN2


 % m is Load no: and n is Generator no:
for m=8
    for n=2
  PLoad8FromGEN2=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad8FromGEN2


 % m is Load no: and n is Generator no:
for m=9
    for n=2
  PLoad9FromGEN2=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad9FromGEN2


 % m is Load no: and n is Generator no:
for m=10
    for n=2
  PLoad10FromGEN2=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad10FromGEN2

 % m is Load no: and n is Generator no:
for m=11
    for n=2
  PLoad11FromGEN2=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad11FromGEN2

 % m is Load no: and n is Generator no:
for m=12
    for n=2
  PLoad12FromGEN2=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad12FromGEN2

 % m is Load no: and n is Generator no:
for m=13
    for n=2
  PLoad13FromGEN2=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
```

```
    end
end
 PLoad13FromGEN2

 % m is Load no: and n is Generator no:
for m=14
    for n=2
  PLoad14FromGEN2=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad14FromGEN2



%-----------------------------------------------------------
%--------------for GENERATOR 3----------------------

% m is Load no: and n is Generator no:
for m=4
    for n=3
  PLoad4FromGEN3=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad4FromGEN3

 % m is Load no: and n is Generator no:
for m=5
    for n=3
  PLoad5FromGEN3=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad5FromGEN3

 % m is Load no: and n is Generator no:
for m=6
    for n=3
  PLoad6FromGEN3=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad6FromGEN3


 % m is Load no: and n is Generator no:
for m=8
    for n=3
  PLoad8FromGEN3=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad8FromGEN3


 % m is Load no: and n is Generator no:
for m=9
```

```
    for n=3
  PLoad9FromGEN3=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad9FromGEN3


 % m is Load no: and n is Generator no:
for m=10
    for n=3
  PLoad10FromGEN3=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad10FromGEN3

 % m is Load no: and n is Generator no:
for m=11
    for n=3
  PLoad11FromGEN3=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad11FromGEN3

 % m is Load no: and n is Generator no:
for m=12
    for n=3
  PLoad12FromGEN3=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad12FromGEN3

 % m is Load no: and n is Generator no:
for m=13
    for n=3
  PLoad13FromGEN3=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad13FromGEN3

 % m is Load no: and n is Generator no:
for m=14
    for n=3
  PLoad14FromGEN3=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad14FromGEN3


%-----------------------------------------------------------
```

```
%--------------for GENERATOR 6----------------------

% m is Load no: and n is Generator no:
for m=4
    for n=6
  PLoad4FromGEN6=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad4FromGEN6

 % m is Load no: and n is Generator no:
for m=5
    for n=6
  PLoad5FromGEN6=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad5FromGEN6

 % m is Load no: and n is Generator no:
for m=6
    for n=6
  PLoad6FromGEN6=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad6FromGEN6


 % m is Load no: and n is Generator no:
for m=8
    for n=6
  PLoad8FromGEN6=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad8FromGEN6


 % m is Load no: and n is Generator no:
for m=9
    for n=6
  PLoad9FromGEN6=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad9FromGEN6


 % m is Load no: and n is Generator no:
for m=10
    for n=6
  PLoad10FromGEN6=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad10FromGEN6
```

```
 % m is Load no: and n is Generator no:
for m=11
    for n=6
  PLoad11FromGEN6=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad11FromGEN6

 % m is Load no: and n is Generator no:
for m=12
    for n=6
  PLoad12FromGEN6=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad12FromGEN6

 % m is Load no: and n is Generator no:
for m=13
    for n=6
  PLoad13FromGEN6=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad13FromGEN6

 % m is Load no: and n is Generator no:
for m=14
    for n=6
  PLoad14FromGEN6=[PLoad(m)/Pbus(m)]*Auinv(m,n)*PG(n);
    end
end
 PLoad14FromGEN6



%-------------------------------------------------------------
 %-------------DOWNSTREAM-LOOKING ALGORITHM-------------
  for m=1:14
    for n=1:14
 Ad(m,n)=-P(m,n)/Pbus(n);
 Ad(1,1)=1;
 Ad(2,2)=1;
 Ad(3,3)=1;
 Ad(4,4)=1;
 Ad(5,5)=1;
 Ad(6,6)=1;
 Ad(7,7)=1;
 Ad(8,8)=1;
 Ad(9,9)=1;
 Ad(10,10)=1;
 Ad(11,11)=1;
 Ad(12,12)=1;
 Ad(13,13)=1;
 Ad(14,14)=1;
 end
```

```
  end

  Ad;

  Adinv=inv(Ad)

  %-----------------------------------------------------------
------
  %-----Contribution of inflow Powers to the load Powers----
--

   %For Load 4
  for m=1:14
    for n=1:14

ContributionOfInflowPowersToTheLoadPower4(m,n)=[P(m,n)/Pbus(
n)]*Adinv(n,4)*PLoad(4);
  end
  end
  ContributionOfInflowPowersToTheLoadPower4


   %For Load 5
  for m=1:14
    for n=1:14

ContributionOfInflowPowersToTheLoadPower5(m,n)=[P(m,n)/Pbus(
n)]*Adinv(n,5)*PLoad(5);
  end
  end
  ContributionOfInflowPowersToTheLoadPower5


   %For Load 6
  for m=1:14
    for n=1:14

ContributionOfInflowPowersToTheLoadPower6(m,n)=[P(m,n)/Pbus(
n)]*Adinv(n,6)*PLoad(6);
  end
  end
  ContributionOfInflowPowersToTheLoadPower6


   %For Load 8
  for m=1:14
    for n=1:14

ContributionOfInflowPowersToTheLoadPower8(m,n)=[P(m,n)/Pbus(
n)]*Adinv(n,8)*PLoad(8);
  end
  end
  ContributionOfInflowPowersToTheLoadPower8
```

```
%For Load 9
for m=1:14
  for n=1:14

ContributionOfInflowPowersToTheLoadPower9(m,n)=[P(m,n)/Pbus(
n)]*Adinv(n,9)*PLoad(9);
end
end
ContributionOfInflowPowersToTheLoadPower9


%For Load 10
for m=1:14
  for n=1:14

ContributionOfInflowPowersToTheLoadPower10(m,n)=[P(m,n)/Pbus
(n)]*Adinv(n,10)*PLoad(10);
end
end
ContributionOfInflowPowersToTheLoadPower10

%For Load 11
for m=1:14
  for n=1:14

ContributionOfInflowPowersToTheLoadPower11(m,n)=[P(m,n)/Pbus
(n)]*Adinv(n,11)*PLoad(11);
end
end
ContributionOfInflowPowersToTheLoadPower11


%For Load 12
for m=1:14
  for n=1:14

ContributionOfInflowPowersToTheLoadPower12(m,n)=[P(m,n)/Pbus
(n)]*Adinv(n,12)*PLoad(12);
end
end
ContributionOfInflowPowersToTheLoadPower12


%For Load 13
for m=1:14
  for n=1:14

ContributionOfInflowPowersToTheLoadPower13(m,n)=[P(m,n)/Pbus
(n)]*Adinv(n,13)*PLoad(13);
end
end
ContributionOfInflowPowersToTheLoadPower13
```

```
    %For Load 14
  for m=1:14
    for n=1:14

ContributionOfInflowPowersToTheLoadPower14(m,n)=[P(m,n)/Pbus
(n)]*Adinv(n,14)*PLoad(14);
  end
  end
  ContributionOfInflowPowersToTheLoadPower14



%--------Contribution of generators powers to the loads-----


 %From Generator 1 To Load 4
  for m=1
    for n=4
   PG1ToLoadPower4=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG1ToLoadPower4


  %From Generator 1 To Load 5
  for m=1
    for n=5
   PG1ToLoadPower5=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG1ToLoadPower5


  %From Generator 1 To Load 6
  for m=1
    for n=6
   PG1ToLoadPower6=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG1ToLoadPower6


 %From Generator 1 To Load 8
  for m=1
    for n=8
   PG1ToLoadPower8=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG1ToLoadPower8


  %From Generator 1 To Load 9
  for m=1
```

```
    for n=9
   PG1ToLoadPower9=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG1ToLoadPower9


  %From Generator 1 To Load 10
  for m=1
    for n=10
   PG1ToLoadPower10=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG1ToLoadPower10


  %From Generator 1 To Load 11
  for m=1
    for n=11
   PG1ToLoadPower11=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG1ToLoadPower11


  %From Generator 1 To Load 12
  for m=1
    for n=12
   PG1ToLoadPower12=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG1ToLoadPower12


  %From Generator 1 To Load 13
  for m=1
    for n=13
   PG1ToLoadPower13=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG1ToLoadPower13


  %From Generator 1 To Load 14
  for m=1
    for n=14
   PG1ToLoadPower14=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG1ToLoadPower14

 %-------------------FOR GENERATOR 2-------------------

 %From Generator 2 To Load 4
```

```
  for m=2
    for n=4
   PG2ToLoadPower4=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG2ToLoadPower4


  %From Generator 2 To Load 5
  for m=2
    for n=5
   PG2ToLoadPower5=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG2ToLoadPower5


  %From Generator 2 To Load 6
  for m=2
    for n=6
   PG2ToLoadPower6=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG2ToLoadPower6

 %From Generator 2 To Load 8
  for m=2
    for n=8
   PG2ToLoadPower8=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG2ToLoadPower8


  %From Generator 2 To Load 9
  for m=2
    for n=9
   PG2ToLoadPower9=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG2ToLoadPower9


  %From Generator 2 To Load 4
  for m=2
    for n=10
   PG2ToLoadPower10=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG2ToLoadPower10


  %From Generator 2 To Load 11
  for m=2
```

```
    for n=11
   PG2ToLoadPower11=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG2ToLoadPower11


  %From Generator 2 To Load 12
  for m=2
    for n=12
   PG2ToLoadPower12=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG2ToLoadPower12


  %From Generator 2 To Load 13
  for m=2
    for n=13
   PG2ToLoadPower13=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG2ToLoadPower13


  %From Generator 2 To Load 14
  for m=2
    for n=14
   PG2ToLoadPower14=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG2ToLoadPower14



 %-------------------FOR GENERATOR 3-------------------

 %From Generator 3 To Load 4
  for m=3
    for n=4
   PG3ToLoadPower4=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG3ToLoadPower4


  %From Generator 3 To Load 5
  for m=3
    for n=5
   PG3ToLoadPower5=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG3ToLoadPower5
```

```
  %From Generator 3 To Load 6
  for m=3
    for n=6
   PG3ToLoadPower6=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG3ToLoadPower6

 %From Generator 3 To Load 8
  for m=3
    for n=8
   PG3ToLoadPower8=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG3ToLoadPower8


  %From Generator 23 To Load 9
  for m=3
    for n=9
   PG3ToLoadPower9=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG3ToLoadPower9


  %From Generator 3 To Load 4
  for m=3
    for n=10
   PG3ToLoadPower10=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG3ToLoadPower10


  %From Generator 3 To Load 11
  for m=3
    for n=11
   PG3ToLoadPower11=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG3ToLoadPower11


  %From Generator 3 To Load 12
  for m=3
    for n=12
   PG3ToLoadPower12=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG3ToLoadPower12
```

```
  %From Generator 3 To Load 13
  for m=3
    for n=13
   PG3ToLoadPower13=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG3ToLoadPower13


  %From Generator 3 To Load 14
  for m=3
    for n=14
   PG3ToLoadPower14=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG3ToLoadPower14



  %------------------FOR GENERATOR 6------------------

 %From Generator 6 To Load 4
  for m=6
    for n=4
   PG6ToLoadPower4=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG6ToLoadPower4


  %From Generator 6 To Load 5
  for m=6
    for n=5
   PG6ToLoadPower5=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG6ToLoadPower5


  %From Generator 6 To Load 6
  for m=6
    for n=6
   PG6ToLoadPower6=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG6ToLoadPower6

 %From Generator 6 To Load 8
  for m=6
    for n=8
   PG6ToLoadPower8=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG6ToLoadPower8
```

```
  %From Generator 6 To Load 9
  for m=6
    for n=9
   PG6ToLoadPower9=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG6ToLoadPower9


  %From Generator 6 To Load 4
  for m=6
    for n=10
   PG6ToLoadPower10=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG6ToLoadPower10


  %From Generator 6 To Load 11
  for m=6
    for n=11
   PG6ToLoadPower11=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG6ToLoadPower11


  %From Generator 6 To Load 12
  for m=6
    for n=12
   PG6ToLoadPower12=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG6ToLoadPower12


  %From Generator 6 To Load 13
  for m=6
    for n=13
   PG6ToLoadPower13=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG6ToLoadPower13


  %From Generator 6 To Load 14
  for m=6
    for n=14
   PG6ToLoadPower14=[PG(m)/Pbus(m)]*Adinv(m,n)*PLoad(n);
    end
end
 PG6ToLoadPower14
```

APPENDIX H

UP-STREAM & DOWN-STREAM LOOKING ALGORITHM FOR 14 BUS REACTIVE POWER

```
% Bus Powers

Qbus(1:14)=[20;32;20;22;17.5;34;36;30;33.5;14;18;16;19;9.5];
%-----------------------------------------------------------

 QLoad(1:14)=[15;0;0;4;7.5;0;5;0;10;4;18;13;19;3.5];
%-----------------------------------------------------------

 %Generators Power
 QG(1:14)=[0;32;13;0;0;24;0;30;0;0;0;0;0;0];
 %----------------------------------------------------------

%-----------------------------------------------------------
 %UPSTREAM-LOOKING ALGORITHM
 %----------------------------------------------------------

 %Line Powers
 Q(1,5)=5;
 Q(2,1)=20;
 Q(2,5)=3;
 Q(2,4)=2;
 Q(2,3)=7;
 Q(3,4)=20;
 Q(4,5)=9.5;
 Q(4,7)=6;
 Q(4,9)=2.5;
 Q(5,6)=10;
 Q(8,7)=30;
 Q(7,9)=31;
 Q(9,10)=14;
 Q(9,14)=9.5;
 Q(10,11)=10;
 Q(6,11)=8;
 Q(6,12)=16;
 Q(6,13)=10;
 Q(12,13)=3;
 Q(14,13)=6;


%-----------------------------------------------------------
```

```
%Matrix Generated From Line Powers and Bus Powers


 for m=1:14
    for n=1:14
 Au(m,n)=-Q(n,m)/Qbus(n);
 Au(1,1)=1;
 Au(2,2)=1;
 Au(3,3)=1;
 Au(4,4)=1;
 Au(5,5)=1;
 Au(6,6)=1;
 Au(7,7)=1;
 Au(8,8)=1;
 Au(9,9)=1;
 Au(10,10)=1;
 Au(11,11)=1;
 Au(12,12)=1;
 Au(13,13)=1;
 Au(14,14)=1;
 end
end

 %Inverse of Generated Matrix
 Au

 Auinv=inv(Au)

 %------Contribution of Generators For Outflow Powers-------
 %------------------------------------------------------------

 %From Generator 2
 for m=1:14
    for n=1:14

ContributionOfGenerator2ForOutflowPowersForLine(m,n)=[Q(m,n)
/Qbus(m)]*Auinv(m,2)*QG(2);
  end
 end
 ContributionOfGenerator2ForOutflowPowersForLine



  %From Generator 3
 for m=1:14
    for n=1:14

ContributionOfGenerator3ForOutflowPowersForLine(m,n)=[Q(m,n)
/Qbus(m)]*Auinv(m,3)*QG(3);
  end
 end
 ContributionOfGenerator3ForOutflowPowersForLine
```

```
  %From Generator 6
 for m=1:14
    for n=1:14

ContributionOfGenerator6ForOutflowPowersForLine(m,n)=[Q(m,n)
/Qbus(m)]*Auinv(m,6)*QG(6);
  end
 end
 ContributionOfGenerator6ForOutflowPowersForLine



  %From Generator 8
 for m=1:14
    for n=1:14

ContributionOfGenerator8ForOutflowPowersForLine(m,n)=[Q(m,n)
/Qbus(m)]*Auinv(m,8)*QG(8);
  end
 end
 ContributionOfGenerator8ForOutflowPowersForLine


%------Contribution of Generators to meet the Load Powers--
%------------------------------------------------------------


%=======FROM GENERATOR 2===============
% m is Load no: and n is Generator no:
for m=1
    for n=2
  QLoad1FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad1FromGEN2


 % m is Load no: and n is Generator no:
for m=4
    for n=2
  QLoad4FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad4FromGEN2



 % m is Load no: and n is Generator no:
for m=5
    for n=2
  QLoad5FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
```

```
 QLoad5FromGEN2


 % m is Load no: and n is Generator no:
for m=7
    for n=2
  QLoad7FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad7FromGEN2

 % m is Load no: and n is Generator no:
for m=9
    for n=2
  QLoad9FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad9FromGEN2


 % m is Load no: and n is Generator no:
for m=10
    for n=2
  QLoad10FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad10FromGEN2


 % m is Load no: and n is Generator no:
for m=11
    for n=2
  QLoad11FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad11FromGEN2


 % m is Load no: and n is Generator no:
for m=12
    for n=2
  QLoad12FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad12FromGEN2


 % m is Load no: and n is Generator no:
for m=13
    for n=2
  QLoad13FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad13FromGEN2
```

```
 % m is Load no: and n is Generator no:
for m=14
    for n=2
  QLoad14FromGEN2=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad14FromGEN2



 %=======FROM GENERATOR 2===============
% m is Load no: and n is Generator no:
for m=1
    for n=3
  QLoad1FromGEN3=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad1FromGEN3


 % m is Load no: and n is Generator no:
for m=4
    for n=3
  QLoad4FromGEN3=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad4FromGEN3



 % m is Load no: and n is Generator no:
for m=5
    for n=3
  QLoad5FromGEN3=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad5FromGEN3


 % m is Load no: and n is Generator no:
for m=7
    for n=3
  QLoad7FromGEN3=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad7FromGEN3

 % m is Load no: and n is Generator no:
for m=9
    for n=3
  QLoad9FromGEN3=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
```

```
end
 QLoad9FromGEN3


 % m is Load no: and n is Generator no:
for m=10
    for n=3
  QLoad10FromGEN3=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad10FromGEN3


 % m is Load no: and n is Generator no:
for m=11
    for n=3
  QLoad11FromGEN3=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad11FromGEN3


  % m is Load no: and n is Generator no:
for m=12
    for n=3
  QLoad12FromGEN3=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad12FromGEN3


  % m is Load no: and n is Generator no:
for m=13
    for n=3
  QLoad13FromGEN3=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad13FromGEN3


  % m is Load no: and n is Generator no:
for m=14
    for n=3
  QLoad14FromGEN3=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad14FromGEN3



 %=======FROM GENERATOR 6==============
% m is Load no: and n is Generator no:
for m=1
    for n=6
```

```
  QLoad1FromGEN6=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad1FromGEN6


 % m is Load no: and n is Generator no:
for m=4
    for n=6
  QLoad4FromGEN6=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad4FromGEN6



 % m is Load no: and n is Generator no:
for m=5
    for n=6
  QLoad5FromGEN6=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad5FromGEN6


 % m is Load no: and n is Generator no:
for m=7
    for n=6
  QLoad7FromGEN6=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad7FromGEN6

 % m is Load no: and n is Generator no:
for m=9
    for n=6
  QLoad9FromGEN6=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad9FromGEN6


 % m is Load no: and n is Generator no:
for m=10
    for n=6
  QLoad10FromGEN6=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad10FromGEN6


 % m is Load no: and n is Generator no:
for m=11
    for n=6
```

```
  QLoad11FromGEN6=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad11FromGEN6


  % m is Load no: and n is Generator no:
for m=12
    for n=6
  QLoad12FromGEN6=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad12FromGEN6


  % m is Load no: and n is Generator no:
for m=13
    for n=6
  QLoad13FromGEN6=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad13FromGEN6


  % m is Load no: and n is Generator no:
for m=14
    for n=6
  QLoad14FromGEN6=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad14FromGEN6



  %=======FROM GENERATOR 8===============
% m is Load no: and n is Generator no:
for m=1
    for n=8
  QLoad1FromGEN8=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad1FromGEN8


 % m is Load no: and n is Generator no:
for m=4
    for n=8
  QLoad4FromGEN8=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad4FromGEN8
```

```
 % m is Load no: and n is Generator no:
for m=5
    for n=8
  QLoad5FromGEN8=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad5FromGEN8


 % m is Load no: and n is Generator no:
for m=7
    for n=8
  QLoad7FromGEN8=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad7FromGEN8

 % m is Load no: and n is Generator no:
for m=9
    for n=8
  QLoad9FromGEN8=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad9FromGEN8


 % m is Load no: and n is Generator no:
for m=10
    for n=8
  QLoad10FromGEN8=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad10FromGEN8


 % m is Load no: and n is Generator no:
for m=11
    for n=8
  QLoad11FromGEN8=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad11FromGEN8


  % m is Load no: and n is Generator no:
for m=12
    for n=8
  QLoad12FromGEN8=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad12FromGEN8


  % m is Load no: and n is Generator no:
```

```
for m=13
    for n=8
  QLoad13FromGEN8=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad13FromGEN8


  % m is Load no: and n is Generator no:
for m=14
    for n=8
  QLoad14FromGEN8=[QLoad(m)/Qbus(m)]*Auinv(m,n)*QG(n);
    end
end
 QLoad14FromGEN8




 %-----------------------------------------------------------
 %DOWNSTREAM-LOOKING ALGORITHM
 %-----------------------------------------------------------

  for m=1:13
    for n=1:13
 Ad(m,n)=-Q(m,n)/Qbus(n);
 Ad(1,1)=1;
 Ad(2,2)=1;
 Ad(3,3)=1;
 Ad(4,4)=1;
 Ad(5,5)=1;
 Ad(6,6)=1;
 Ad(7,7)=1;
 Ad(8,8)=1;
 Ad(9,9)=1;
 Ad(10,10)=1;
 Ad(11,11)=1;
 Ad(12,12)=1;
 Ad(13,13)=1;
 Ad(14,14)=1;
  end
  end
%Inverse of downstream matrix
  Ad;
    Adinv=inv(Ad)
```

```
%-----------------------------------------------------------
 %Contribution of inflow Powers to the load Powers
%------------------------------------------------------------

 %For Load 1
 for m=1:14
   for n=1:14

ContributionOfInflowPowersToTheLoadPower1(m,n)=[Q(m,n)/Qbus(
n)]*Adinv(n,1)*QLoad(1);
    end
 end
 ContributionOfInflowPowersToTheLoadPower1


  %For Load 4
 for m=1:14
   for n=1:14

ContributionOfInflowPowersToTheLoadPower4(m,n)=[Q(m,n)/Qbus(
n)]*Adinv(n,4)*QLoad(4);
    end
 end
 ContributionOfInflowPowersToTheLoadPower4


  %For Load 5
 for m=1:14
   for n=1:14

ContributionOfInflowPowersToTheLoadPower5(m,n)=[Q(m,n)/Qbus(
n)]*Adinv(n,5)*QLoad(5);
    end
 end
 ContributionOfInflowPowersToTheLoadPower5


  %For Load 7
 for m=1:14
   for n=1:14

ContributionOfInflowPowersToTheLoadPower7(m,n)=[Q(m,n)/Qbus(
n)]*Adinv(n,7)*QLoad(7);
    end
 end
 ContributionOfInflowPowersToTheLoadPower7


  %For Load 9
 for m=1:14
   for n=1:14

ContributionOfInflowPowersToTheLoadPower9(m,n)=[Q(m,n)/Qbus(
n)]*Adinv(n,9)*QLoad(9);
```

```
    end
  end
  ContributionOfInflowPowersToTheLoadPower9

   %For Load 10
  for m=1:14
    for n=1:14

ContributionOfInflowPowersToTheLoadPower10(m,n)=[Q(m,n)/Qbus
(n)]*Adinv(n,10)*QLoad(10);
    end
  end
  ContributionOfInflowPowersToTheLoadPower10


   %For Load 11
  for m=1:14
    for n=1:14

ContributionOfInflowPowersToTheLoadPower11(m,n)=[Q(m,n)/Qbus
(n)]*Adinv(n,11)*QLoad(11);
    end
  end
  ContributionOfInflowPowersToTheLoadPower11

  %For Load 12
  for m=1:14
    for n=1:14

ContributionOfInflowPowersToTheLoadPower12(m,n)=[Q(m,n)/Qbus
(n)]*Adinv(n,12)*QLoad(12);
    end
  end
  ContributionOfInflowPowersToTheLoadPower12


   %For Load 13
  for m=1:14
    for n=1:14

ContributionOfInflowPowersToTheLoadPower13(m,n)=[Q(m,n)/Qbus
(n)]*Adinv(n,13)*QLoad(13);
    end
  end
  ContributionOfInflowPowersToTheLoadPower13


   %For Load 14
  for m=1:14
    for n=1:14

ContributionOfInflowPowersToTheLoadPower14(m,n)=[Q(m,n)/Qbus
(n)]*Adinv(n,14)*QLoad(14);
    end
```

```
end
ContributionOfInflowPowersToTheLoadPower14



%------------------------------------------------------------
%-------Contribution of generators powers to the loads----
%------------------------------------------------------------

%------------------FROM GENRATOR 2--------------------

%From Generator 2 To Load 1
for m=2
  for n=1
 QG2ToLoadPower1=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
  end
end
 QG2ToLoadPower1


%From Generator 2 To Load 4
for m=2
  for n=4
 QG2ToLoadPower4=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
  end
end
 QG2ToLoadPower4


%From Generator 2 To Load 5
for m=2
  for n=5
 QG2ToLoadPower5=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
  end
end
 QG2ToLoadPower5

%From Generator 2 To Load 7
for m=2
  for n=7
 QG2ToLoadPower7=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
  end
end
 QG2ToLoadPower7


%From Generator 2 To Load 9
for m=2
  for n=9
 QG2ToLoadPower9=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
  end
end
 QG2ToLoadPower9
```

```
%From Generator 2 To Load 10
 for m=2
   for n=10
  QG2ToLoadPower10=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
   end
end
 QG2ToLoadPower10

 %From Generator 2 To Load 11
  for m=2
    for n=11
   QG2ToLoadPower11=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG2ToLoadPower11

 %From Generator 2 To Load 12
  for m=2
    for n=12
   QG2ToLoadPower12=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG2ToLoadPower12

 %From Generator 2 To Load 13
  for m=2
    for n=13
   QG2ToLoadPower13=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG2ToLoadPower13

 %From Generator 2 To Load 14
  for m=2
    for n=14
   QG2ToLoadPower14=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
  end
   QG2ToLoadPower14



  %------------------FROM GENRATOR 3--------------------

 %From Generator 3 To Load 1
 for m=3
   for n=1
  QG3ToLoadPower1=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
   end
end
```

```
 QG3ToLoadPower1


 %From Generator 3 To Load 4
  for m=3
    for n=4
   QG3ToLoadPower4=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG3ToLoadPower4


 %From Generator 3 To Load 5
  for m=3
    for n=5
   QG3ToLoadPower5=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG3ToLoadPower5

 %From Generator 3 To Load 7
  for m=3
    for n=7
   QG3ToLoadPower7=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG3ToLoadPower7


 %From Generator 3 To Load 9
  for m=3
    for n=9
   QG3ToLoadPower9=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG3ToLoadPower9


 %From Generator 3 To Load 10
  for m=3
    for n=10
   QG3ToLoadPower10=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG3ToLoadPower10

 %From Generator 32 To Load 11
  for m=3
    for n=11
   QG3ToLoadPower11=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG3ToLoadPower11
```

```
 %From Generator 3 To Load 12
  for m=3
    for n=12
   QG3ToLoadPower12=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG3ToLoadPower12

 %From Generator 3 To Load 13
  for m=3
    for n=13
   QG3ToLoadPower13=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG3ToLoadPower13

 %From Generator 3 To Load 14
  for m=3
    for n=14
   QG3ToLoadPower14=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
  end
   QG3ToLoadPower14



   %------------------FROM GENRATOR 6-------------------

  %From Generator 6 To Load 1
  for m=6
    for n=1
   QG6ToLoadPower1=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG6ToLoadPower1


 %From Generator 6 To Load 4
  for m=6
    for n=4
   QG6ToLoadPower4=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG6ToLoadPower4


 %From Generator 6 To Load 5
  for m=6
    for n=5
   QG6ToLoadPower5=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG6ToLoadPower5
```

```
%From Generator 6 To Load 7
 for m=6
   for n=7
  QG6ToLoadPower7=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
   end
end
 QG6ToLoadPower7


%From Generator 6 To Load 9
 for m=6
   for n=9
  QG6ToLoadPower9=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
   end
end
 QG6ToLoadPower9


%From Generator 6 To Load 10
 for m=6
   for n=10
  QG6ToLoadPower10=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
   end
end
 QG6ToLoadPower10

%From Generator 6 To Load 11
 for m=6
   for n=11
  QG6ToLoadPower11=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
   end
end
 QG6ToLoadPower11

%From Generator 6 To Load 12
 for m=6
   for n=12
  QG6ToLoadPower12=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
   end
end
 QG6ToLoadPower12

%From Generator 6 To Load 13
 for m=6
   for n=13
  QG6ToLoadPower13=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
   end
end
 QG6ToLoadPower13

%From Generator 6 To Load 14
 for m=6
   for n=14
  QG6ToLoadPower14=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
```

```
      end
    end
     QG6ToLoadPower14


     %-------------------FROM GENRATOR 8--------------------

    %From Generator 8 To Load 1
    for m=8
      for n=1
     QG8ToLoadPower1=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
      end
  end
   QG8ToLoadPower1


   %From Generator 8 To Load 4
    for m=8
      for n=4
     QG8ToLoadPower4=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
      end
  end
   QG8ToLoadPower4


   %From Generator 8 To Load 5
    for m=8
      for n=5
     QG8ToLoadPower5=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
      end
  end
   QG8ToLoadPower5

   %From Generator 8 To Load 7
    for m=8
      for n=7
     QG8ToLoadPower7=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
      end
  end
   QG8ToLoadPower7


   %From Generator 8 To Load 9
    for m=8
      for n=9
     QG8ToLoadPower9=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
      end
  end
   QG8ToLoadPower9


   %From Generator 8 To Load 10
    for m=8
```

```
    for n=10
   QG8ToLoadPower10=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG8ToLoadPower10

 %From Generator 8 To Load 11
  for m=8
    for n=11
   QG8ToLoadPower11=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG8ToLoadPower11

 %From Generator 8 To Load 12
  for m=8
    for n=12
   QG8ToLoadPower12=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG8ToLoadPower12

 %From Generator 8 To Load 13
  for m=8
    for n=13
   QG8ToLoadPower13=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
end
 QG8ToLoadPower13

 %From Generator 8 To Load 14
  for m=8
    for n=14
   QG8ToLoadPower14=[QG(m)/Qbus(m)]*Adinv(m,n)*QLoad(n);
    end
  end
   QG8ToLoadPower14
```

Appendix I

Up-Stream & Down-Stream Looking Algorithm Results for 9 & 14 bus system

9 BUS POWER FLOW DATA

Bus	PGen	QGen	PLoad	QLoad
01	71.735	24.07	0	15.46
02	161.515	14.02	0	0
03	84.23	40.95	0	0
04	0	0	0	0
05	0	0	90.81	0
06	0	0	0	0
07	0	0	100.305	41.45
08	0	25	0	0
09	0	0	126.365	40
10	0	0	0	3.32
11	0	14.38	0	0
12	0	0	0	0
13	0	16.18	0	10

From Bus	To Bus	Line	P Flow
01	04	01	71.735
04	05	02	30.64
04	09	03	41.095
06	05	04	60.17
08	09	05	85.27
02	08	06	161.515
03	06	07	84.23
06	07	08	24.06
08	07	09	76.245

From Bus	To Bus	Line	Q Flow
01	10	01	24.07
10	04	02	20.75
04	05	03	9.41
04	11	04	11.34
11	09	05	25.72
13	05	06	6.05
12	09	07	14.28
06	13	08	16.05
12	08	09	2.53
02	03	10	14.02
03	06	11	40.95
06	07	12	24.90
08	07	13	16.55

9 BUS SYSTEM ACTIVE POWER'S RESULTS

UP-STREAM LOOKING ALGORTHIM

Auinv =

1.0000	0	0	0	0	0	0	0	0
0	1.0000	0	0	0	0	0	0	0
0	0	1.0000	0	0	0	0	0	0
1.0000	0	0	1.0000	0	0	0	0	0
0.4271	0	0.7229	0.4271	1.0000	0.7144	0	0	0
0	0	1.0120	0	0	1.0000	0	0	0
0	0.4721	0.2891	0	0	0.2856	1.0000	0.4721	0
0	1.0000	0	0	0	0	0	1.0000	0
0.5729	0.5279	0	0.5729	0	0	0	0.5279	1.0000

ContributionOfGenerator1ForOutflowPowersForLine =

0	0	0	71.7350	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	30.6400	0	0	0	41.0950
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0

```
ContributionOfGenerator2ForOutflowPowersForLine =

         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0  161.5150         0
         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0   76.2450         0   85.2700


ContributionOfGenerator3ForOutflowPowersForLine =

         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0
         0         0         0         0         0   84.2300         0         0         0
         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0
         0         0         0         0   60.1700         0   24.0600         0         0
         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0
```

PLoad5FromGEN1 = 30.6400

PLoad7FromGEN1 = 0

PLoad9FromGEN1 = 41.0950

PLoad5FromGEN2 = 0

PLoad7FromGEN2 = 76.2450

PLoad9FromGEN2 = 85.2700

PLoad5FromGEN3 = 60.1700

PLoad7FromGEN3 = 24.0600

PLoad9FromGEN3 = 0

```
Adinv =

    1.0000         0         0    1.0000    0.3374         0         0         0    0.3252
         0    1.0000         0         0         0         0    0.7601    1.0000    0.6748
         0         0    1.0000         0    0.6626    1.0000    0.2399         0         0
         0         0         0    1.0000    0.3374         0         0         0    0.3252
         0         0         0         0    1.0000         0         0         0         0
         0         0         0         0    0.6626    1.0000    0.2399         0         0
         0         0         0         0         0         0    1.0000         0         0
         0         0         0         0         0         0    0.7601    1.0000    0.6748
         0         0         0         0         0         0         0         0    1.0000


ContributionOfInflowPowersToTheLoadPower5 =

         0         0         0   30.6400         0         0         0         0         0
         0         0         0         0         0         0         0         0         0
         0         0         0         0         0   60.1700         0         0         0
         0         0         0         0   30.6400         0         0         0         0
         0         0         0         0         0         0         0         0         0
         0         0         0         0   60.1700         0         0         0         0
         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0
```

ContributionOfInflowPowersToTheLoadPower7 =

0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	76.2450	0
0	0	0	0	0	24.0600	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	24.0600	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	76.2450	0	0

ContributionOfInflowPowersToTheLoadPower9 =

0	0	0	41.0950	0	0	0	0	0
0	0	0	0	0	0	0	85.2700	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	41.0950
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	85.2700

PG1ToLoadPower5 = 30.6400

PG1ToLoadPower7 = 0

PG1ToLoadPower9 = 41.0950

PG2ToLoadPower5 = 0

PG2ToLoadPower7 = 76.2450

PG2ToLoadPower9 = 85.2700

PG3ToLoadPower5 = 60.1700

PG3ToLoadPower7 = 24.0600

PG3ToLoadPower9 = 0

9 BUS SYSTEM REACTIVE POWER'S RESULTS

UP-STREAM LOOKING ALGORTHIM

Auinv =

1.0000	0	0	0	0	0	0	0	0	0	0	0	0
0	1.0000	0	0	0	0	0	0	0	0	0	0	0
0	0	1.0000	0	0	0	0	0	0	0	0	0	0
0.8621	0	0	1.0000	0	0	0	0	0	0.8621	0	0	0
0.3944	0	0.1477	0.4575	1.0000	0.1477	0	0	0	0.3944	0	0	0.3769
0	0	1.0000	0	0	1.0000	0	0	0	0	0	0	0
0	1.0000	0.6081	0	0	0.6081	1.0000	1.0000	0	0	0	0.1505	0
0	1.0000	0	0	0	0	0	1.0000	0	0	0	0.1505	0
0.4752	0	0	0.5513	0	0	0	0	1.0000	0.4752	1.0000	0.8495	0
1.0000	0	0	0	0	0	0	0	0	1.0000	0	0	0
0.4752	0	0	0.5513	0	0	0	0	0	0.4752	1.0000	0	0
0	0	0	0	0	0	0	0	0	0	0	1.0000	0
0	0	0.3919	0	0	0.3919	0	0	0	0	0	0	1.0000

ContributionOfGenerator1ForOutflowPowersForLine =

0	0	0	0	0	0	0	0	0	24.0700	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	9.4923	0	0	0	0	0	11.4392	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	20.7500	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	11.4392	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0

ContributionOfGenerator2ForOutflowPowersForLine =

0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	14.0200	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	14.0200	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0

ContributionOfGenerator3ForOutflowPowersForLine =

0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	40.9500	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	24.9000	0	0	0	0	0	16.0500
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	6.0500	0	0	0	0	0	0	0	0

ContributionOfGenerator11ForOutflowPowersForLine =

0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	14.3800	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0

ContributionOfGenerator12ForOutflowPowersForLine =

0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	2.5300	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	2.5300	14.2800	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0

QLoad5FromGEN1 = 9.4923

QLoad7FromGEN1 = 0

QLoad9FromGEN1 = 11.4392

QLoad10FromGEN1 = 3.3200

QLoad13FromGEN1 = 0

QLoad5FromGEN2 = 0

QLoad7FromGEN2 = 14.0200

QLoad9FromGEN2 = 0

QLoad10FromGEN2 = 0

QLoad13FromGEN2 = 0

QLoad5FromGEN3 = 6.0500

QLoad7FromGEN3 = 24.9000

QLoad9FromGEN3 = 0

QLoad10FromGEN3 = 0

QLoad13FromGEN3 = 10

QLoad5FromGEN11 = 0

QLoad7FromGEN11 = 0

QLoad9FromGEN11 = 14.3800

QLoad10FromGEN11 = 0

QLoad13FromGEN11 = 0

QLoad5FromGEN12 = 0

QLoad7FromGEN12 = 2.5300

QLoad9FromGEN12 = 14.2800

QLoad10FromGEN12 = 0

QLoad13FromGEN12 = 0

DOWN-STREAM LOOKING ALGORTHIM

Adinv =

1.0000	0	0	1.0088	0.6140	0	0	0	0.2860	1.0000	0.4448	0	0
0	1.0000	0	0	0	0	0.3382	0.8471	0	0	0	0	0
0	0	1.0000	0	0.3913	1.0000	0.6007	0	0	0	0	0	1.0000
0	0	0	1.0000	0.6087	0	0	0	0.2835	0	0.4409	0	0
0	0	0	0	1.0000	0	0	0	0	0	0	0	0
0	0	0	0	0.3913	1.0000	0.6007	0	0	0	0	0	1.0000
0	0	0	0	0	0	1.0000	0	0	0	0	0	0
0	0	0	0	0	0	0.3993	1.0000	0	0	0	0	0
0	0	0	0	0	0	0	0	1.0000	0	0	0	0
0	0	0	1.0088	0.6140	0	0	0	0.2860	1.0000	0.4448	0	0
0	0	0	0	0	0	0	0	0.6430	0	1.0000	0	0
0	0	0	0	0	0	0.0610	0.1529	0.3570	0	0	1.0000	0
0	0	0	0	0.3913	0	0	0	0	0	0	0	1.0000

ContributionOfInflowPowersToTheLoadPower5 =

0	0	0	0	0	0	0	0	0	9.4923	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	6.0500	0	0	0	0	0	0	0
0	0	0	0	9.4100	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	6.0500
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	9.4923	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	6.0500	0	0	0	0	0	0	0	0

ContributionOfInflowPowersToTheLoadPower7 =

0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	14.0200	0	0	0	0	0
0	0	0	0	0	24.9000	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	24.9000	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	16.5500	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	2.5300	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0

ContributionOfInflowPowersToTheLoadPower9 =

0	0	0	0	0	0	0	0	0	11.4392	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	11.3400	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	11.4392	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	25.7200	0	0	0	0
0	0	0	0	0	0	0	0	14.2800	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0

ContributionOfInflowPowersToTheLoadPower10 =

0	0	0	0	0	0	0	0	0	3.3200	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0

ContributionOfInflowPowersToTheLoadPower13 =

0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	10	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	10
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0

QG1ToLoadPower5 = 9.4923

QG1ToLoadPower7 = 0

QG1ToLoadPower9 = 11.4392

QG1ToLoadPower10 = 3.3200

QG1ToLoadPower13 = 0

QG2ToLoadPower5 = 0

QG2ToLoadPower7 = 14.0200

QG2ToLoadPower9 = 0

QG2ToLoadPower10 = 0

QG2ToLoadPower13 = 0

QG3ToLoadPower5 = 6.0500

QG3ToLoadPower7 = 24.9000

QG3ToLoadPower9 = 0

QG3ToLoadPower10 = 0

QG3ToLoadPower13 = 10

QG11ToLoadPower5 = 0

QG11ToLoadPower7 = 0

QG11ToLoadPower9 = 14.3800

QG11ToLoadPower10 = 0

QG11ToLoadPower13 = 0

QG12ToLoadPower5 = 0

QG12ToLoadPower7 = 2.5300

QG12ToLoadPower9 = 14.2800

QG12ToLoadPower10 = 0

QG12ToLoadPower13 = 0

14 BUS POWER FLOW DATA

-

Bus	PGen	QGen	PLoad	QLoad
01	232	0	0	15
02	40	32	0	0
03	69	13	0	0
04	0	0	150	4
05	0	0	11	7.5
06	100	24	10	0
07	0	0	0	5
08	0	25	43	0
09	0	0	30	10
10	0	0	8	4
11	0	0	4	18
12	0	0	50	13
13	0	0	117	19
14	0	0	18	3.5

From Bus	To Bus	Line	P Flow
01	02	01	157
01	05	02	75
02	04	03	55
02	05	04	41
02	03	05	101
03	04	06	170
04	07	07	70
04	09	08	65
05	04	09	60
05	06	10	45
06	11	11	8
06	12	12	109
06	13	13	18
07	09	14	27
07	08	15	43
09	10	16	4
09	14	17	58
11	10	18	4
12	13	19	59
14	13	20	40

From Bus	To Bus	Line	Q Flow
02	01	01	20
01	05	02	5
02	04	03	2
02	05	04	3
02	03	05	7
03	04	06	20
04	07	07	6
04	09	08	2.5
05	04	09	9.5
05	06	10	10
06	11	11	8
06	12	12	16
06	13	13	10
07	09	14	31
08	07	15	30
09	10	16	14
09	14	17	9.5
10	11	18	10
12	13	19	3
14	13	20	6

14 BUS SYSTEM FOR ACTIVE POWER'S RESULTS

UP-STREAM LOOKING ALGORTHIM

```
Auinv =

  Columns 1 through 11

    1.0000         0         0         0         0         0         0         0         0         0         0
    0.6767    1.0000         0         0         0         0         0         0         0         0         0
    0.3469    0.5127    1.0000         0         0         0         0         0         0         0         0
    0.7759    0.8995    1.0000    1.0000    0.5172         0         0         0         0         0         0
    0.4641    0.2081         0         0    1.0000         0         0         0         0         0         0
    0.1800    0.0807         0         0    0.3879    1.0000         0         0         0         0         0
    0.1906    0.2209    0.2456    0.2456    0.1270         0    1.0000         0         0         0         0
    0.1171    0.1357    0.1509    0.1509    0.0780         0    0.6143    1.0000         0         0         0
    0.2505    0.2904    0.3228    0.3228    0.1670         0    0.3857         0    1.0000         0         0
    0.0159    0.0149    0.0140    0.0140    0.0180    0.0276    0.0168         0    0.0435    1.0000    0.5000
    0.0099    0.0045         0         0    0.0214    0.0552         0         0         0         0    1.0000
    0.1353    0.0607         0         0    0.2916    0.7517         0         0         0         0         0
    0.2045    0.1691    0.1404    0.1404    0.2786    0.5310    0.1677         0    0.4348         0         0
    0.1579    0.1831    0.2035    0.2035    0.1053         0    0.2432         0    0.6304         0         0

  Columns 12 through 14

         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
    1.0000         0         0
    0.5413    1.0000    0.6897
         0         0    1.0000
```

ContributionOfGenerator1ForOutflowPowersForLine =

Columns 1 through 11

0	157.0000	0	0	75.0000	0	0	0	0	0	0
0	0	80.4924	43.8325	32.6751	0	0	0	0	0	0
0	0	0	80.4924	0	0	0	0	0	0	0
0	0	0	0	0	0	44.2152	0	41.0569	0	0
0	0	0	55.6940	0	41.7705	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	2.3046
0	0	0	0	0	0	0	27.1607	17.0544	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	2.5266	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1.1523	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0

Columns 12 through 14

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
31.3999	5.1853	0
0	0	0
0	0	0
0	0	36.6354
0	0	0
0	0	0
0	16.9963	0
0	0	0
0	25.2658	0

```
ContributionOfGenerator2ForOutflowPowersForLine =

  Columns 1 through 11

         0         0         0         0         0         0         0         0         0         0         0
         0         0   20.5076   11.1675    8.3249         0         0         0         0         0         0
         0         0         0   20.5076         0         0         0         0         0         0         0
         0         0         0         0         0         0    8.8375         0    8.2062         0         0
         0         0         0    4.3060         0    3.2295         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0    0.1782
         0         0         0         0         0         0         0    5.4287    3.4087         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0    0.5050         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0    0.0891         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0

  Columns 12 through 14

         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
    2.4277    0.4009         0
         0         0         0
         0         0         0
         0         0    7.3225
         0         0         0
         0         0         0
         0    1.3141         0
         0         0         0
         0    5.0500         0
```

```
ContributionOfGenerator3ForOutflowPowersForLine =

  Columns 1 through 11

         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0   69.0000         0         0         0         0         0         0         0
         0         0         0         0         0         0   16.9474         0   15.7368         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0   10.4105    6.5368         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0    0.9684         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0

  Columns 12 through 14

         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0   14.0421
         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0    9.6842         0
```

```
ContributionOfGenerator6ForOutflowPowersForLine =

  Columns 1 through 11

         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0    5.5172
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0    2.7586         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0

  Columns 12 through 14

         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
   75.1724   12.4138         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0   40.6897         0
         0         0         0
         0         0         0
```

PLoad4FromGEN1 = 94.7468

PLoad5FromGEN1 = 10.2106

PLoad6FromGEN1 = 2.8807

PLoad8FromGEN1 = 27.1607

PLoad9FromGEN1 = 18.9494

PLoad10FromGEN1 = 3.6789

PLoad11FromGEN1 = 1.1523

PLoad12FromGEN1 = 14.4036

PLoad13FromGEN1 = 47.4474

PLoad14FromGEN1 = 11.3696

PLoad4FromGEN2 = 18.9374

PLoad5FromGEN2 = 0.7894

PLoad6FromGEN2 = 0.2227

PLoad8FromGEN2 = 5.4287

PLoad9FromGEN2 = 3.7875

PLoad10FromGEN2 = 0.5941

PLoad11FromGEN2 = 0.0891

PLoad12FromGEN2 = 1.1136

PLoad13FromGEN2 = 6.7649

PLoad14FromGEN2 = 2.2725

PLoad4FromGEN3 = 36.3158

PLoad5FromGEN3 = 0

PLoad6FromGEN3 = 0

PLoad8FromGEN3 = 10.4105

PLoad9FromGEN3 = 7.2632

PLoad10FromGEN3 = 0.9684

PLoad11FromGEN3 = 0

PLoad12FromGEN3 = 0

PLoad13FromGEN3 = 9.6842

PLoad14FromGEN3 = 4.3579

PLoad4FromGEN6 = 0

PLoad5FromGEN6 = 0

PLoad6FromGEN6 = 6.8966

PLoad8FromGEN6 = 0

PLoad9FromGEN6 = 0

PLoad10FromGEN6 = 2.7586

PLoad11FromGEN6 = 2.7586

PLoad12FromGEN6 = 34.4828

PLoad13FromGEN6 = 53.1034

PLoad14FromGEN6 = 0

DOWN-STREAM LOOKING ALGORTHIM

```
Adinv =

  Columns 1 through 13

    1.0000    0.7970    0.4735    0.6316    0.9282    0.2881    0.6316    0.6316    0.6316    0.4599    0.2881    0.2881    0.4055
         0    1.0000    0.5941    0.6218    0.3534    0.1097    0.6218    0.6218    0.6218    0.3657    0.1097    0.1097    0.2848
         0         0    1.0000    0.5965         0         0    0.5965    0.5965    0.5965    0.2982         0         0    0.2039
         0         0         0    1.0000         0         0    1.0000    1.0000    1.0000    0.5000         0         0    0.3419
         0         0         0    0.2105    1.0000    0.3103    0.2105    0.2105    0.2105    0.2604    0.3103    0.3103    0.2762
         0         0         0         0         0    1.0000         0         0         0    0.5000    1.0000    1.0000    0.6581
         0         0         0         0         0         0    1.0000    1.0000    0.2935    0.1467         0         0    0.1003
         0         0         0         0         0         0         0    1.0000         0         0         0         0         0
         0         0         0         0         0         0         0         0    1.0000    0.5000         0         0    0.3419
         0         0         0         0         0         0         0         0         0    1.0000         0         0         0
         0         0         0         0         0         0         0         0         0    0.5000    1.0000         0         0
         0         0         0         0         0         0         0         0         0         0         0    1.0000    0.5043
         0         0         0         0         0         0         0         0         0         0         0         0    1.0000
         0         0         0         0         0         0         0         0         0         0         0         0    0.3419

  Column 14

    0.6316
    0.6218
    0.5965
    1.0000
    0.2105
         0
    0.2935
         0
    1.0000
         0
         0
         0
         0
    1.0000
```

ContributionOfInflowPowersToTheLoadPower4 =

Columns 1 through 11

0	74.3294	0	0	20.4174	0	0	0	0	0	0
0	0	53.1579	28.9474	11.1615	0	0	0	0	0	0
0	0	0	89.4737	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	31.5789	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0

Columns 12 through 14

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

```
ContributionOfInflowPowersToTheLoadPower5 =

  Columns 1 through 13

         0    3.0985         0         0    7.1121         0         0         0         0         0         0         0         0
         0         0         0         0    3.8879         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0

  Column 14

         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
```

```
ContributionOfInflowPowersToTheLoadPower6 =

  Columns 1 through 13

         0    0.8742         0         0    2.0065         0         0         0         0         0         0         0         0
         0         0         0         0    1.0969         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0    3.1034         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0

  Column 14

         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
```

```
ContributionOfInflowPowersToTheLoadPower8 =

  Columns 1 through 13

         0   21.3078         0         0    5.8530         0         0         0         0         0         0         0         0
         0         0   15.2386    8.2982    3.1996         0         0         0         0         0         0         0         0
         0         0         0   25.6491         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0   43.0000         0         0         0         0         0         0
         0         0         0    9.0526         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0   43.0000         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0

  Column 14

         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
```

```
ContributionOfInflowPowersToTheLoadPower9 =

  Columns 1 through 13

         0   14.8659         0         0    4.0835         0         0         0         0         0         0         0         0
         0         0   10.6316    5.7895    2.2323         0         0         0         0         0         0         0         0
         0         0         0   17.8947         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0    8.8043         0   21.1957         0         0         0         0
         0         0         0    6.3158         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0    8.8043         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0

  Column 14

         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
```

```
CContributionOfInflowPowersToTheLoadPower11 =

  Columns 1 through 13

         0    0.3497         0         0    0.8026         0         0         0         0         0         0         0         0
         0         0         0         0    0.4388         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0    1.2414         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0    4.0000         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0

  Column 14

         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
```

```
ContributionOfInflowPowersToTheLoadPower12 =

  Columns 1 through 13

         0    4.3709         0         0   10.0327         0         0         0         0         0         0         0         0
         0         0         0         0    5.4845         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0   15.5172         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0   50.0000         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0

  Column 14

         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
```

```
ContributionOfInflowPowersToTheLoadPower13 =

  Columns 1 through 13

         0   26.5524         0         0   20.8950         0         0         0         0         0         0         0         0
         0         0   14.1754    7.7193   11.4226         0         0         0         0         0         0         0         0
         0         0         0   23.8596         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0   11.7391         0   28.2609         0         0         0         0
         0         0         0    8.4211         0   23.8966         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0   59.0000   18.0000
         0         0         0         0         0         0         0         0   11.7391         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0   59.0000
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0   40.0000

  Column 14

         0
         0
         0
         0
         0
         0
         0
         0
   40.0000
         0
         0
         0
         0
         0
```

```
ContributionOfInflowPowersToTheLoadPower14 =

  Columns 1 through 13

         0    8.9195         0         0    2.4501         0         0         0         0         0         0         0         0
         0         0    6.3789    3.4737    1.3394         0         0         0         0         0         0         0         0
         0         0         0   10.7368         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0    5.2826         0   12.7174         0         0         0         0
         0         0         0    3.7895         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0    5.2826         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0

  Column 14

         0
         0
         0
         0
         0
         0
         0
         0
   18.0000
         0
         0
         0
         0
         0
```

PG1ToLoadPower4 = 94.7468

PG1ToLoadPower5 = 10.2106

PG1ToLoadPower6 = 2.8807

PG1ToLoadPower8 = 27.1607

PG1ToLoadPower9 = 18.9494

PG1ToLoadPower10 = 3.6789

PG1ToLoadPower11 = 1.1523

PG1ToLoadPower12 = 14.4036

PG1ToLoadPower13 = 47.4474

PG1ToLoadPower14 = 11.3696

PG2ToLoadPower4 = 18.9374

PG2ToLoadPower5 = 0.7894

PG2ToLoadPower6 = 0.2227

PG2ToLoadPower8 = 5.4287

PG2ToLoadPower9 = 3.7875

PG2ToLoadPower10 = 0.5941

PG2ToLoadPower11 = 0.0891

PG2ToLoadPower12 = 1.1136

PG2ToLoadPower13 = 6.7649

PG2ToLoadPower14 = 2.2725

PG3ToLoadPower4 = 36.3158

PG3ToLoadPower5 = 0

PG3ToLoadPower6 = 0

PG3ToLoadPower8 = 10.4105

PG3ToLoadPower9 = 7.2632

PG3ToLoadPower10 = 0.9684

PG3ToLoadPower11 = 0

PG3ToLoadPower12 = 0

PG3ToLoadPower13 = 9.6842

PG3ToLoadPower14 = 4.3579

PG6ToLoadPower4 = 0

PG6ToLoadPower5 = 0

PG6ToLoadPower6 = 6.8966

PG6ToLoadPower8 = 0

PG6ToLoadPower9 = 0

PG6ToLoadPower10 = 2.7586

PG6ToLoadPower11 = 2.7586

PG6ToLoadPower12 = 34.4828

PG6ToLoadPower13 = 53.1034

PG6ToLoadPower14 = 0

14 BUS SYSTEM FOR REACTIVE POWER'S RESULTS

UP-STREAM LOOKING ALGORITHM

Auinv =

Columns 1 through 11

1.0000	0.6250	0	0	0	0	0	0	0	0	0
0	1.0000	0	0	0	0	0	0	0	0	0
0	0.2188	1.0000	0	0	0	0	0	0	0	0
0	0.2813	1.0000	1.0000	0	0	0	0	0	0	0
0.2500	0.3714	0.4318	0.4318	1.0000	0	0	0	0	0	0
0.1429	0.2123	0.2468	0.2468	0.5714	1.0000	0	0	0	0	0
0	0.0767	0.2727	0.2727	0	0	1.0000	1.0000	0	0	0
0	0	0	0	0	0	0	1.0000	0	0	0
0	0.0980	0.3485	0.3485	0	0	0.8611	0.8611	1.0000	0	0
0	0.0410	0.1456	0.1456	0	0	0.3599	0.3599	0.4179	1.0000	0
0.0336	0.0792	0.1621	0.1621	0.1345	0.2353	0.2570	0.2570	0.2985	0.7143	1.0000
0.0672	0.0999	0.1161	0.1161	0.2689	0.4706	0	0	0	0	0
0.0546	0.0987	0.1568	0.1568	0.2185	0.3824	0.1542	0.1542	0.1791	0	0
0	0.0278	0.0988	0.0988	0	0	0.2442	0.2442	0.2836	0	0

Columns 12 through 14

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
1.0000	0	0
0.1875	1.0000	0.6316
0	0	1.0000

ContributionOfGenerator2ForOutflowPowersForLine =

```
  Columns 1 through 11

        0         0         0         0    5.0000         0         0         0         0         0         0
  20.0000         0    7.0000    2.0000    3.0000         0         0         0         0         0         0
        0         0         0    7.0000         0         0         0         0         0         0         0
        0         0         0         0    3.8864         0    2.4545         0    1.0227         0         0
        0         0         0         0         0    6.7922         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0    1.5982
        0         0         0         0         0         0         0         0    2.1136         0         0
        0         0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0    1.3107         0
        0         0         0         0         0         0         0         0         0         0    0.9362
        0         0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0         0

  Columns 12 through 14

        0         0         0
        0         0         0
        0         0         0
        0         0         0
        0         0         0
   3.1963    1.9977         0
        0         0         0
        0         0         0
        0         0    0.8894
        0         0         0
        0         0         0
        0    0.5993         0
        0         0         0
        0    0.5617         0
```

ContributionOfGenerator3ForOutflowPowersForLine =

Columns 1 through 10

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	13.0000	0	0	0	0	0	0
0	0	0	0	5.6136	0	3.5455	0	1.4773	0
0	0	0	0	0	3.2078	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	3.0530	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1.8933
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

Columns 11 through 14

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0.7548	1.5095	0.9435	0
0	0	0	0
0	0	0	0
0	0	0	1.2847
1.3523	0	0	0
0	0	0	0
0	0	0.2830	0
0	0	0	0
0	0	0.8114	0

ContributionOfGenerator6ForOutflowPowersForLine =

```
  Columns 1 through 10

         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0

  Columns 11 through 14

         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
    5.6471   11.2941    7.0588         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0    2.1176         0
         0         0         0         0
         0         0         0         0
```

ContributionOfGenerator8ForOutflowPowersForLine =

Columns 1 through 10

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	25.8333	0
0	0	0	0	0	0	30.0000	0	0	0
0	0	0	0	0	0	0	0	0	10.7960
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

Columns 11 through 14

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	7.3259
7.7114	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	4.6269	0

QLoad1FromGEN2 = 15

QLoad4FromGEN2 = 1.6364

QLoad5FromGEN2 = 5.0942

QLoad7FromGEN2 = 0.3409

QLoad9FromGEN2 = 0.9362

QLoad10FromGEN2 = 0.3745

QLoad11FromGEN2 = 2.5344

QLoad12FromGEN2 = 2.5970

QLoad13FromGEN2 = 3.1588

QLoad14FromGEN2 = 0.3277

QLoad1FromGEN3 = 0

QLoad4FromGEN3 = 2.3636

QLoad5FromGEN3 = 2.4058

QLoad7FromGEN3 = 0.4924

QLoad9FromGEN3 = 1.3523

QLoad10FromGEN3 = 0.5409

QLoad11FromGEN3 = 2.1071

QLoad12FromGEN3 = 1.2265

QLoad13FromGEN3 = 2.0379

QLoad14FromGEN3 = 0.4733

QLoad1FromGEN6 = 0

QLoad4FromGEN6 = 0

QLoad5FromGEN6 = 0

QLoad7FromGEN6 = 0

QLoad9FromGEN6 = 0

QLoad10FromGEN6 = 0

QLoad11FromGEN6 = 5.6471

QLoad12FromGEN6 = 9.1765

QLoad13FromGEN6 = 9.1765

QLoad14FromGEN6 = 0

QLoad1FromGEN8 = 0

QLoad4FromGEN8 = 0

QLoad5FromGEN8 = 0

QLoad7FromGEN8 = 4.1667

QLoad9FromGEN8 = 7.7114

QLoad10FromGEN8 = 3.0846

QLoad11FromGEN8 = 7.7114

QLoad12FromGEN8 = 0

QLoad13FromGEN8 = 4.6269

QLoad14FromGEN8 = 2.6990

DOWN-STREAM LOOKING ALGORITHM

Adinv =

Columns 1 through 10

1.0000	0	0	0	0.2857	0.0840	0	0	0	0
1.0000	1.0000	0.3500	0.4091	0.6792	0.1998	0.0682	0	0.0936	0.0936
0	0	1.0000	0.9091	0.4935	0.1451	0.1515	0	0.2081	0.2081
0	0	0	1.0000	0.5429	0.1597	0.1667	0	0.2289	0.2289
0	0	0	0	1.0000	0.2941	0	0	0	0
0	0	0	0	0	1.0000	0	0	0	0
0	0	0	0	0	0	1.0000	0	0.9254	0.9254
0	0	0	0	0	0	0.8333	1.0000	0.7711	0.7711
0	0	0	0	0	0	0	0	1.0000	1.0000
0	0	0	0	0	0	0	0	0	1.0000
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

Columns 11 through 14

0.0373	0.0840	0.0575	0
0.1408	0.1998	0.1367	0
0.1801	0.1451	0.0993	0
0.1981	0.1597	0.1092	0
0.1307	0.2941	0.2012	0
0.4444	1.0000	0.6842	0
0.5141	0	0	0
0.4284	0	0	0
0.5556	0	0	0
0.5556	0	0	0
1.0000	0	0	0
0	1.0000	0.1579	0
0	0	1.0000	0
0	0	0	1.0000

ContributionOfInflowPowersToTheLoadPower1 =

0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0

ContributionOfInflowPowersToTheLoadPower4 =

Columns 1 through 10

0	0	0	0	0	0	0	0	0	0
0	0	1.2727	0.3636	0	0	0	0	0	0
0	0	0	3.6364	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

Columns 11 through 14

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

ContributionOfInflowPowersToTheLoadPower5 =

Columns 1 through 10

0	0	0	0	2.1429	0	0	0	0	0
2.1429	0	1.2955	0.3701	1.2857	0	0	0	0	0
0	0	0	3.7013	0	0	0	0	0	0
0	0	0	0	4.0714	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

Columns 11 through 14

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

ContributionOfInflowPowersToTheLoadPower7 =

```
Columns 1 through 10

         0         0         0         0         0         0         0         0         0         0
         0         0    0.2652    0.0758         0         0         0         0         0         0
         0         0         0    0.7576         0         0         0         0         0         0
         0         0         0         0         0         0    0.8333         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0    4.1667         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0

Columns 11 through 14

         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
```

ContributionOfInflowPowersToTheLoadPower9 =

Columns 1 through 10

0	0	0	0	0	0	0	0	0	0
0	0	0.7282	0.2081	0	0	0	0	0	0
0	0	0	2.0805	0	0	0	0	0	0
0	0	0	0	0	0	1.5423	0	0.7463	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	9.2537	0
0	0	0	0	0	0	7.7114	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

Columns 11 through 14

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

ContributionOfInflowPowersToTheLoadPower10 =

```
Columns 1 through 10

        0         0         0         0         0         0         0         0         0         0
        0         0    0.2913    0.0832         0         0         0         0         0         0
        0         0         0    0.8322         0         0         0         0         0         0
        0         0         0         0         0         0    0.6169         0    0.2985         0
        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0    3.7015         0
        0         0         0         0         0         0    3.0846         0         0         0
        0         0         0         0         0         0         0         0         0    4.0000
        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0
        0         0         0         0         0         0         0         0         0         0

Columns 11 through 14

        0         0         0         0
        0         0         0         0
        0         0         0         0
        0         0         0         0
        0         0         0         0
        0         0         0         0
        0         0         0         0
        0         0         0         0
        0         0         0         0
        0         0         0         0
        0         0         0         0
        0         0         0         0
        0         0         0         0
        0         0         0         0
```

ContributionOfInflowPowersToTheLoadPower11 =

Columns 1 through 10

0	0	0	0	0.6723	0	0	0	0	0
0.6723	0	1.1346	0.3242	0.4034	0	0	0	0	0
0	0	0	3.2417	0	0	0	0	0	0
0	0	0	0	1.2773	0	1.5423	0	0.7463	0
0	0	0	0	0	2.3529	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	9.2537	0
0	0	0	0	0	0	7.7114	0	0	0
0	0	0	0	0	0	0	0	0	10.0000
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

Columns 11 through 14

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
8.0000	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
10.0000	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

ContributionOfInflowPowersToTheLoadPower12 =

Columns 1 through 10

0	0	0	0	1.0924	0	0	0	0	0
1.0924	0	0.6604	0.1887	0.6555	0	0	0	0	0
0	0	0	1.8869	0	0	0	0	0	0
0	0	0	0	2.0756	0	0	0	0	0
0	0	0	0	0	3.8235	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

Columns 11 through 14

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	13.0000	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

ContributionOfInflowPowersToTheLoadPower13 =

Columns 1 through 10

0	0	0	0	1.0924	0	0	0	0	0
1.0924	0	0.6604	0.1887	0.6555	0	0	0	0	0
0	0	0	1.8869	0	0	0	0	0	0
0	0	0	0	2.0756	0	0	0	0	0
0	0	0	0	0	3.8235	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

Columns 11 through 14

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	3.0000	10.0000	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	3.0000	0
0	0	0	0
0	0	6.0000	0

ContributionOfInflowPowersToTheLoadPower14 =

```
  Columns 1 through 10

         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0

  Columns 11 through 14

         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0    3.5000
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
         0         0         0         0
```

QG2ToLoadPower1 = 15

QG2ToLoadPower4 = 1.6364

QG2ToLoadPower5 = 5.0942

QG2ToLoadPower7 = 0.3409

QG2ToLoadPower9 = 0.9362

QG2ToLoadPower10 = 0.3745

QG2ToLoadPower11 = 2.5344

QG2ToLoadPower12 = 2.5970

QG2ToLoadPower13 = 2.5970

QG2ToLoadPower14 = 0

QG3ToLoadPower1 = 0

QG3ToLoadPower4 = 2.3636

QG3ToLoadPower5 = 2.4058

QG3ToLoadPower7 = 0.4924

QG3ToLoadPower9 = 1.3523

QG3ToLoadPower10 = 0.5409

QG3ToLoadPower11 = 2.1071

QG3ToLoadPower12 = 1.2265

QG3ToLoadPower13 = 1.2265

QG3ToLoadPower14 = 0

QG6ToLoadPower1 = 0

QG6ToLoadPower4 = 0

QG6ToLoadPower5 = 0

QG6ToLoadPower7 = 0

QG6ToLoadPower9 = 0

QG6ToLoadPower10 = 0

QG6ToLoadPower11 = 5.6471

QG6ToLoadPower12 = 9.1765

QG6ToLoadPower13 = 9.1765

QG6ToLoadPower14 = 0

QG8ToLoadPower1 = 0

QG8ToLoadPower4 = 0

QG8ToLoadPower5 = 0

QG8ToLoadPower7 = 4.1667

QG8ToLoadPower9 = 7.7114

QG8ToLoadPower10 = 3.0846

QG8ToLoadPower11 = 7.7114

QG8ToLoadPower12 = 0

QG8ToLoadPower13 = 0

QG8ToLoadPower14 = 0

Project Milestone for Final Year Project II

No.	Detail/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Project Work Continue														
2	Submission of Progress Report 1				●										
3	Project Work Continue														
4	Submission of Progress Report 2								●						
5	Project Work Continue														
6	Draft Report													●	
7	Final Report														●
8	Technical Report														●

● Suggested Milestone

Process